Volume Six

MEN AND PLANES

THE ARMY AIR FORCES

In World War II

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FOREWORD to the New Imprint

IN March 1942, President Franklin D. Roosevelt wrote to the Director of the Bureau of the Budget ordering each war agency to prepare "an accurate and objective account" of that agency's war experience. Soon after, the Army Air Forces began hiring professional historians so that its history could, in the words of Brigadier General Laurence Kuter, "be recorded while it is hot and that personnel be selected and an agency set up for a clear historian's job without axe to grind or defense to prepare." An Historical Division was established in Headquarters Army Air Forces under Air Intelligence, in September 1942, and the modern Air Force historical program began.

With the end of the war, Headquarters approved a plan for writing and publishing a seven-volume history. In December 1945, Lieutenant General Ira C. Eaker, Deputy Commander of Army Air Forces, asked the Chancellor of the University of Chicago to "assume the responsibility for the publication" of the history, stressing that it must "meet the highest academic standards." Lieutenant Colonel Wesley Frank Craven of New York University and Major James Lea Cate of the University of Chicago, both of whom had been assigned to the historical program, were selected to be editors of the volumes. Between 1948 and 1958 seven were published. With publication of the last, the editors wrote that the Air Force had "fulfilled in letter and spirit" the promise of access to documents and complete freedom of historical interpretation. Like all history, *The Army Air Forces in World War II* reflects the era when it was conceived, researched, and written. The strategic bombing campaigns received the primary emphasis, not only because of a widely-shared belief in bombardment's con-

tribution to victory, but also because of its importance in establishing the United States Air Force as a military service independent of the Army. The huge investment of men and machines and the effectiveness of the combined Anglo-American bomber offensive against Germany had not been subjected to the critical scrutiny they have since received. Nor, given the personalities involved and the immediacy of the events, did the authors question some of the command arrangements. In the tactical area, to give another example, the authors did not doubt the effect of aerial interdiction on both the German withdrawal from Sicily and the allied landings at Anzio.

Editors Craven and Cate insisted that the volumes present the war through the eyes of the major commanders, and be based on information available to them as important decisions were made. At the time, secrecy still shrouded the Allied code-breaking effort. While the link between decoded message traffic and combat action occasionally emerges from these pages, the authors lacked the knowledge to portray adequately the intelligence aspects of many operations, such as the interdiction in 1943 of Axis supply lines to Tunisia and the systematic bombardment, beginning in 1944, of the German oil industry.

All historical works a generation old suffer such limitations. New information and altered perspective inevitably change the emphasis of an historical account. Some accounts in these volumes have been superseded by subsequent research and other portions will be superseded in the future. However, these books met the highest of contemporary professional standards of quality and comprehensiveness. They contain information and experience that are of great value to the Air Force today and to the public. Together they are the only comprehensive discussion of Army Air Forces activity in the largest air war this nation has ever waged. Until we summon the resources to take a fresh, comprehensive look at the Army Air Forces' experience in World War II, these seven volumes will continue to serve us as well for the next quarter century as they have for the last.

RICHARD H. KOHN
Chief, Office of Air Force History

FOREWORD

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THE five volumes of this series which have been published heretofore completed the story of the combat activities of the Army Air Forces in the several theaters, a story that began with Pearl Harbor and came to a victorious close within a few days after the atomic bombing of Hiroshima and Nagasaki. The present volume, VI, deals with the Zone of the Interior—with the development of an effective air organization, with the forging and distribution of weapons, with the recruiting and training of airmen.

It was not without much forethought and some misgivings that the editors relegated these vital activities to a separate volume, thus removing them from the immediate context of the combat operations which were their constant guide and indeed their very *raison d'être*. The alternative—and it was seriously considered—would have been to intersperse the combat narrative with isolated chapters dealing with concurrent developments within the United States. To follow that pattern, it seemed, would interrupt such continuity as the editors had been able to give to a very complex story of air operations conducted simultaneously on a number of fronts. Furthermore, the decision to divide the combat narrative into two parallel sets of volumes dealing with the war against the European Axis (Vols. I, II, III) and against Japan (Vols. I, IV, V) would have made it difficult for readers interested primarily in organization, personnel, and materiel to have found all pertinent information without the formidable expenditure of time required to go through the whole set. So, for better or worse, the editors decided to sketch in a short analysis of the basic problems of the air arm and the solutions thereto in Volume I, and to refer briefly in proper context to such stateside matters of men and weapons as affected immediately the conduct of war in the several theaters, meanwhile reserving for the present volume a fuller elucidation of those

topics. Inevitably this has made for some duplication, but it is an enrichment rather than mere repetition. To borrow a simile from the teaching profession, the present volume bears somewhat the same relation to earlier scattered references as the advanced or graduate course in history does to the freshman survey, and the editors' occasional experience with a student who fancied he had absorbed all that was useful in tabloid form during his first semester has not altered their estimate of the importance and the interest of the expanded treatment presented herewith.

The three sections of this volume deal respectively with the organization and mission of the Army Air Forces; with the development, production, distribution, and servicing of equipment; and with the recruiting and training of airmen. While the emphasis is on the war years, there is for each topic a preliminary discussion that begins at some appropriate time in the 1930's, when the foundations for the AAF were being laid.

In the development of organization, the year 1935 proved to be a turning point. Under the influence of Billy Mitchell, aviation enthusiasts, military and civilian alike, had long fought for a separate air arm. The Baker Board, whose report of July 1934 was accepted as public policy, denied the existence of an independent air mission and, consequently, the need for an independent air force. Thereafter most airmen ceased to struggle for the separate organization, deriving such comfort as they might from a provision of the Baker report which when adopted in 1935 allowed them to concentrate all their tactical units under one command, the newly formed GHQ Air Force. Any hopes for immediate improvement were soon dissipated. The division of responsibilities for procurement and training, and for operations, between the Office, Chief of the Air Corps (OCAC) and the GHQ Air Force led to friction. Procurement of the modest increase of aircraft recommended by the Baker Board lagged far behind schedule. Especially galling to the airman was the War Department's negative attitude toward the big bomber, now available in the B-17, both in respect to procurement and to the development of doctrine.

Changes in that attitude, with attendant changes in the Air Corps' organization and mission, were forced by international crises abroad. It was the Munich crisis, and the obvious importance of the Luftwaffe in Hitler's diplomatic victory, that persuaded President Roosevelt of the need for an immediate and vast expansion of American air

power. His successful request in January 1939 for a large defense appropriation provided the necessary means, but it soon became apparent that the President, with his deep concern for the preservation of the nations of western Europe, was more interested in accelerating aircraft production than in the orderly building of all those elements which together constitute an air force.

The German blitz in the spring of 1940 furthered the transition toward the wartime air force. Expansion was no longer conceived in terms of planes alone, but as a rational program to provide the bases, pilots, mechanics, and equipment for a given number of tactical groups. The number of groups changed frequently under further threats from abroad—from 24 to 54 to 84 and eventually by further accretions to the ultimate 273-group program—but in spite of the constant shifting in estimates of the number and nature of the groups needed, the programs gave structure to the Air Corps in a period of expansion unprecedented in the short history of aviation.

There were increased pressures from outside the military establishment for an independent air arm with cabinet representation, but the threat of war made so radical an experiment dangerous. General Marshall, who became Chief of Staff in 1939, had become increasingly sympathetic toward the airman's view, though he preferred evolution to revolution as a means of effecting needed changes in the command structure; General Arnold, who had been named Chief of the Air Corps in the previous year, favored a more rapid transition but worked loyally with Marshall. A compromise solution reached in November 1940 proved disappointing and was scrapped on 20 June 1941 by Army Regulation 95-5, which established the Army Air Forces, whose Chief (Arnold) was to serve as Deputy Chief of Staff for Air. A comparable change had occurred at the level of civilian leadership. Henry L. Stimson had been named Secretary of War in June of 1940; soon afterward he brought into his office Robert A. Lovett, who in the following spring became Assistant Secretary of War for Air. This team of Stimson and Lovett, Marshall and Arnold was to hold together through the war; the ability of its several members to work harmoniously together was perhaps more important than any structural changes that were made.

From lessons learned from the Battle of Britain the Air Corps gained an increased responsibility in air defense of the United States, and from preliminary strategic agreements with Great Britain

(ABC-1, March 1941) an offensive mission of its own. By spring of 1941 there had emerged four numbered air forces, each combining certain regional defense duties with a training mission. Under AR 95-9, Arnold was supposed to coordinate the activities of the various OCAC agencies and of the GHQ Air Force, now redesignated Air Force Combat Command. This proved difficult to do, and there were inevitably conflicts in authority between his office and GHQ, which had been activated in July 1940. Various proposals for improved command channels were made but none had been agreed on when war came to make an early solution imperative.

That solution came on 9 March 1942 and it was significant that the new directive was merely in the form of a War Department circular, a suggestion of impermanence that was ill founded since the arrangement made was to outlast the war. GHQ was abolished. To handle Zone of Interior duties three autonomous and coordinate commands were set up under the Chief of Staff: the Army Air Forces, Army Ground Forces, and Services of Supply (later Army Service Forces). The OCAC and the AFCC were abolished and the functions of the former were divided among an enlarged AAF staff.

Literally, this made of the AAF a subordinate command within the Army, with a Zone of Interior mission "to organize, train, and equip air units for assignment to combat theaters." But actually, if without official sanction, the AAF became an autonomous branch of the service, on a level with the Army and Navy rather than with AGF and ASF. In part this was occasioned by the necessary inclusion of an airman in all topside decisions on strategy, a need which was given formal sanction by the appointment of Arnold to the Joint Chiefs of Staff and the Combined Chiefs of Staff on an equal plane with Marshall, who was technically his superior in the War Department. Through his personal connections with AAF commanders in the several theaters Arnold was able also to affect significantly if indirectly the actual conduct of operations, so that both at home and abroad the activities of AAF Headquarters went far beyond a literal adherence to its stated mission.

In that headquarters there was throughout the war a willingness to experiment with administrative procedures and agencies; offices changed designations with a rapidity that was reflected in almost each new Pentagon telephone directory, and in some instances the transformation may have seemed hardly more than finding new titles for

familiar officers performing familiar tasks in familiar rooms. In part the experimental mood derived from the lack of any deeply entrenched traditions, in part from the liberal use by Arnold of civilian personnel and techniques in office management. The Air Staff had been established in 1941 along conventional military lines (with A's instead of G's), and on this pattern was superimposed for a while a system of directorates borrowed from the RAF. These latter were abolished in 1943 in the AAF's third successive spring housecleaning, one which in effect established the essential structure of the Washington headquarters for the duration of hostilities. Changes thereafter were in detail rather than in over-all design, the one important exception being an attempt to operate the Twentieth Air Force from the Pentagon with a special staff.

Changes at Washington were closely linked with changes among the operating agencies in the United States. Early in the war the pattern for combat units—squadron, group, wing—was set, though there was an appreciable variety as between different types of units at each level. As the air arm grew in size the wing lost some of its earlier importance as an administrative unit; the standard large-scale combat organization became the numbered air force, divided functionally into commands—bomber, fighter, air service, etc. The four such air forces permanently assigned to the United States continued to divide their energies between their defensive mission, which was regional, and their task of training combat crews and units, with a steady growth in the relative importance of training over defense after 1942.

In its other functions—individual training, development and procurement of materiel, air transport, weather, communications, etc.—the AAF tried in turn several systems of control. Amid the frequent changes in detail, two general trends may be observed: one away from regional controls inherited from the Army in favor of functional structures, the other a move toward decentralization to relieve an overcrowded Washington. There emerged a number of commands (or comparable organizations such as the Army Airways Communications System), each with a field headquarters reporting directly to top-level echelons at Washington. Before the end of the war the Continental Air Forces was established as a coordinating agency between the numbered air forces and AAF Headquarters.

The evolution toward autonomy and toward a structure built along novel functional lines absorbed a considerable amount of the interest

and energies of the higher AAF officers, but it was accomplished without serious detriment to the main issue of winning the war, and the accumulated experience of the war years was reflected in the total reorganization of the defense structure after victory came.

In its defense mission, the AAF was never tested except in antisubmarine activities, a role which it assumed adventitiously and by default. Although most arguments in favor of an enlarged air force in the period between the two wars had been couched in terms of defense, the emphasis was rather on antishipping than on anti-air activities. Thus in 1942 when threats of war and the improved performance of aircraft made bomber attacks against the United States a possibility, the Air Corps found itself long on offensive doctrine, short on plans for air defense. Fortunately our increasingly close relations with Britain made available the expert advice of those men who were currently operating the world's most effective air defense. The activation of the Air Defense Command in February 1940 provided a small staff for coordination of information drawn from RAF visitors, from Air Corps observers of the Battle of Britain, and from Army maneuvers in the United States. From Britain came not only information concerning defense organization and tactics but invaluable scientific and technological secrets in the field of electronics. By the spring of 1941 the four numbered air forces, each with its interceptor command, had been made responsible for air defense within its respective area, with passive measures under control of the Office of Civilian Defense.

Shortage of qualified personnel and of equipment made it impossible to establish rapidly the elaborate system envisaged, with its radar stations, ground observers, and filter and control systems, its AA guns and fighters, its barrage balloons, smoke generators, and blackouts; tests late in 1941 showed up many flaws. The fact that war came with a surprise air attack on U.S. territory as distant from Tokyo as was our eastern seaboard from Germany put an abrupt end to any complacency, at least on the east and west coasts, which were immediately established as theaters of operations. The new concern for the safety of our shores brought a great increase in civilian volunteers, but it brought also from many communities demands for fighters and AA guns that could not be met. Fortunately defense leaders refused to yield to local pressures to the extent of parcelling out our very limited fighter strength among the many claimants. Improvements in

organization and control and increases in available equipment eventually provided an adequate defense except against hit-and-run attacks. By spring of 1943 the JCS had approved a plan for calculated risks in defense and within a year most of the vast organizations had been dismantled or put on a stand-by basis. Actually the system had never been tried, the only serious attacks coming later in the form of incendiaries sent from Japan in free balloons; but the very considerable cost of the air defense organization had been justified by its strategic purpose of protecting our industrial centers, by its contribution to training in the AAF, and by the confidence it gave to our citizens.

As General Arnold pointed out on more than one occasion, an air force was made up of planes, flying and ground crews, and bases; an orderly expansion called for a balancing of needs in each of those categories. The air installations in active use when Air Corps expansion was authorized in 1939 were for the most part relics of World War I, though some were of more recent construction; in all they included seventeen air bases, four air depots, and six bombing and gunnery ranges. Some help was obtained from the WPA and CAA in building civil air fields that were a needed adjunct to those of the Air Corps. Methods employed in siting, acquiring, and building the military fields were speeded up; responsibility for construction passed from the Quartermaster Corps to the Corps of Engineers, and a general policy was adopted of using "permanent" materials (brick or concrete) only for technical buildings. The 54-group program was the basis of the development plan until Pearl Harbor; thereafter each new program through that calling for 273 groups brought an upward revision of housing needs for training and defense. Arnold tended to discourage the limitless demands from local communities for defense fields and to stress the prior need of training fields, where he demanded an adherence to "Spartan simplicity."

The tar-paper barracks housing cadets differed radically from the hotels, some of them famous resort hostelries, which were rented as quarters for various technical training programs. This device was a great time saver and not as costly in the long run as might have been expected, even in a highly publicized case where the hotel was bought outright and later resold. Before the end of 1943, AAF installations in the United States had reached a peak figure of 345 main bases, 116 subbases, 322 auxiliary fields, 12 air depots, 68 specialized depots and 480 bombing and gunnery ranges; thereafter, as additional units

moved overseas and the training establishment shrank, contraction began with the closing of some fields, the transfer to the Navy of others, and the termination of some leases.

In planning the expenditure of over $3 billion, the AAF and its building agencies made mistakes. Expansion in some categories continued after contraction had begun in others; some fields were in use only a short time and some were not ideally located; there was needless and expensive duplication with the Navy and a lack of sharing between the two air arms. But the training and defense programs were never seriously retarded by lack of facilities and the expenditures have not been judged exorbitant by wartime standards. Some satisfaction may be derived from the fact that though local pressures were exerted in favor of this or that location, the AAF suffered less on this score than earlier since the very multiplicity of pressures tended to weaken the power of any.

During the years 1939–45 the United States produced military aircraft and related equipment in such quantities as to be able to equip its own Army and Navy air forces and to extend material aid to other opponents of the Axis powers. The remarkable achievements in the development and production of air weapons were made possible by the collaboration of science, industry, labor, and the military establishment; here, appropriately, the emphasis has been directed toward the part played by the AAF without implying that it was the dominant factor in success.

When rearmament began in 1939, the Air Corps had little in the way of equipment and almost no modern planes. Except for the B-17, it had no aircraft type equal in performance to the best in England or Germany. National resources for aeronautical research and development were potentially rich but as yet not oriented toward the rapid creation of a first-line air force. In part this was the result of the small appropriations granted to the Air Corps in the period since World War I, but the lack of agreement as to the air mission was also a severe handicap since it prevented any long-range planning. This latter weakness was partially overcome by the report in June 1939 of the Kilner Board which by formulating the needs of the Air Corps in the various categories of combat planes provided a general guide for design competition within the aircraft industry.

That industry was pretty well concentrated in a handful of companies which had survived the depression. They had been kept alive

only by virtue of government contracts for military planes, and that source of business was too erratic to encourage plant expansion or the adoption of elaborate production-line techniques. Early plans for industrial mobilization were inadequate and were based on an impractical idea of type freezing for quantity production, a concept incompatible with the rapid rate of improvement under the stress of war. Aircraft manufacturers were slow to expand facilities at their own expense for what might be only a brief period of enlarged sales, and it seemed impolitic to reopen recent debates over government ownership of factories. Fortunately, the dilemma was resolved by the great wave of British and French orders which helped finance plant expansion, although the foreign orders in turn were to constitute a serious threat to the immediate buildup of an American air force in being.

Because of the long time-lag between the original conception of a combat airplane and its quantity production, it was fortunate that the new emphasis on research and development came no later. As it was, some of the planes with which the AAF fought the war were developed before the Kilner report, and all were in production or under development before Pearl Harbor. Yet among the limited number of types that reached the production stage there were numerous changes which greatly enhanced performance in such categories as speed, altitude, range, firepower, and payload while adding various safety devices. Most of the various aircraft became familiar to the public through their official AAF designations or the more picturesque names given by their manufacturers, but it was only an expert who could recognize the successive models, each incorporating some significant improvement by which a fighter's range might be vastly extended or a medium bomber's useful load increased beyond the original capacity of the pre–Pearl Harbor heavy bomber.

The constant modifications were a vital necessity since at the beginning of the war some enemy planes were superior to our current models in certain significant characteristics. Before the war ended the United States had at least one airplane in each conventional class that was equal to the enemy's best and in some categories—such as the very heavy bomber and transport planes—AAF superiority was beyond any challenge. Because of the system of competitive bids used in developing new airplane types, in most categories there were two or more planes of roughly equal merit, with special merits and defects about balancing out. In some cases the balance was so even as to

foster unending arguments between pilots and crews of rival planes—the B-17 versus the B-24, the P-47 versus the P-51. In other cases the contest was less equal: there was never a successful American rival to the C-47, the B-29, the B-25, or the AT-6. Where an American plane was superior to that of the enemy the margin might be slight or it might fluctuate with each succeeding model. The one respect in which U.S. planes were almost universally superior was in their heavy and rugged construction which insured a relatively high survival ratio of both plane and crew.

Since available resources were not unlimited—particularly in respect to scientists and technicians—there was an unending competition between programs for long-range research and development on the one hand and for improvement and production of existing models on the other. Inevitably the latter had priority during the early period of rearmament but eventually a happier balance was achieved. The first revision of the five-year program based on the Kilner report came as early as April 1940, and subsequently other changes were made in the over-all program and among its internal priorities. A better utilization of resources was achieved by a closer coordination between the Air Staff and Wright Field and the various contributing agencies, military and civilian alike. The exchange of information with the British was fruitful, too, particularly in the field of electronics. But the AAF still depended most heavily upon industry for research and development.

Perhaps this policy was in part responsible for the fact that in general the AAF was more successful during the war in improving existing weapons than in developing radically new ones. The B-29 was perhaps the most spectacular exception in that by a crash program of development and production the plane was put into operation early enough to play a decisive role in the Pacific war. To the development of the war's most spectacular weapon, the atomic bomb, the AAF contributed almost nothing. In two other radical innovations, jet planes and guided missiles, America lagged far behind Germany. Conversely, by various expedients the AAF was able to extend vastly the range of its fighters to remedy its most glaring pre-war omission, an escort for long-range bombers. In retrospect, the failure to produce a jet fighter seems most serious since the Germans might have used their jets very effectively had their leadership been better, but in the pragmatic test of the air victory AAF policy seems to have been jus-

tified for that particular war, and the jet P-80 and the transcontinental B-36, both developed during the war, were to provide some security in the early post-war years.

In the production of conventional aircraft, where the U.S. record was much more impressive than in the development of radically new weapons, the Air Corps' part was chiefly advisory. With the beginning of rearmament in 1939, General Arnold and his staff assumed responsibility for an early and vast increase in the number of planes manufactured. Funds were provided to that end in such staggering sums as to be almost embarrassing to an air arm long nurtured on economy, but existing facilities in the aeronautical industry were unequal to the new demands, and in planning for expansion of production capacity air leaders had to compete with the needs of other military services. The steadily deteriorating international situation made for frequent upward revisions of the Air Corps' estimated needs and consequently of actual production schedules.

President Roosevelt's tendency to state objectives in huge round figures had a calculated effect on public opinion, but such estimates had to be translated into more precise military terms. Thus his call in May 1940 for 50,000 planes a year became the basis for the First Aviation Objective, the 54-group program. So long as we were at peace there was a reasonable question as to whether we were more interested in manufacturing a given number of planes (which would age rapidly) or in building up and maintaining productive capacity. The latter policy finally won out, largely because of the President's decision to give a high priority in the assignment of planes to those nations already fighting the Axis powers. This decision alleviated the danger that the equipping of U.S. combat units might result in the accumulation of a surplus of obsolescent planes.

In anticipation of an accelerating production rate, the AAF in March 1941 set its Second Aviation Objective at eighty-four groups. Then in August, when the President asked for an estimate of "overall production requirements" for victory over the Axis, the goal was sharply extended. In AWPD/1, an air plan which with remarkable foresight provided a strategic and logistical blueprint for the imminent conflict, Arnold's staff asked for 239 groups, a figure not far from the actual maximum of 243 which were fully equipped in 1945. This plan, incorporated in the President's Victory Program and in Anglo-American agreements, was brought under review immediately after Pearl

Harbor when the AAF extended its ultimate demands in AWPD/4 and, consonant with Roosevelt's demands for 80,000 planes in 1942 and 125,000 in 1943, stepped up its more immediate requirements in a 115-group program.

The full mobilization of all military forces after Pearl Harbor threatened the high priority which the President's policies had given to aircraft production, and by August 1942 a realistic appreciation of production capacity and certain changes in military strategy demanded a review of the whole production picture. Arnold submitted a new plan, AWPD/42, calling for a total output of 131,000 planes in 1943, of which the AAF's share would be used to equip 281 groups. This demand was sharply challenged by the Navy and by October the AAF (and the President) had accepted a compromise figure of 107,000 planes for 1943. This marked the end of the overriding priority for aircraft among the various categories of munitions, but the AAF had little cause for complaint. Rather there was some danger that acceptances of aircraft might outrun the availability of combat crews or of shipping to support the planes in combat theaters and, while the AAF maintained an official position of standing pat on existing schedules, some leaders acknowledged privately that it might be necessary to reduce demands to accord with actual production records. It was realized that round-figure goals were deceiving; that the record could be, and in some cases actually was, padded out by the continuance of planes no longer considered first class. A far more revealing index was in terms of total airframe weight, and thus expressed, the production score became increasingly impressive with the trend toward heavier bombers and larger transports.

In any event, it was relatively easy to secure approval for a total of 120,000 planes for 1944, with the AAF adhering to a program of 273 groups. Peak strength was reached in March 1945 with 269¼ groups in being, of which 243 were fully equipped. Even before that, the AAF had begun plans for contraction. Each of these major changes in policy, and other factors as well, were reflected in the constant revision of the detailed production schedules, which attempted to reconcile the requests of the various users—AAF, Navy, and British—with production potentials. Scheduling was a responsibility, after January 1942, of the Aircraft Production Board, "virtually a separate organization within the WPB," acting through its executive agency, the Aircraft Resources Control Office.

The conspicuous success of the production program was made possible only by bold planning and initial expansion in the period between the Battle of France and Pearl Harbor. Before 1940 airplanes were largely manufactured by handwork; by the end of 1942 the transition to mass production methods had occurred and the automotive industry was in a process of conversion to support the expanded aircraft factories.

Before 1938, M-day plans for mobilizing the aircraft industry were concerned with preventing competition only among U.S. military agencies; reflecting current concepts of the air mission, those plans were hopelessly inadequate to provide guidance for Roosevelt's startling demands. In 1939, some use was made of so-called "educational orders" as a means of encouraging and measuring the possibility of expansion of munitions factories, but the sums allocated for Air Corps use were insignificant. The real incentive to expand came from foreign orders, a type of business which had been under severe criticism in those years when all makers of arms were attacked as "merchants of death." Under the impetus of war in Europe, however, public opinion and government policy changed; the Neutrality Act was modified to allow sale of munitions by the "cash and carry" method and France and England began ordering U.S. aircraft. At first these were obsolescent planes, but in March 1940 the rules were liberalized, with full support of the Air Corps, to allow the export of more recent models. With the fall of France, Britain became the sole important foreign customer, greatly increasing her orders first on her own credit and after March 1941 through lend-lease, a program in which aircraft heavily outweighed all other munitions.

As constituted in 1939, the U.S. aircraft industry did not have the capacity to produce within acceptable time limits the planes wanted by foreign nations and our own Army and Navy. Expansion was necessary and four alternatives were considered: 1) government factories; 2) an increase of plant capacity by the aircraft industry itself; 3) more subcontracting by the major companies to smaller aircraft firms and to organizations outside the aircraft industry; and 4) conversion of other industries, especially the automotive. Of these methods, only the second was acceptable to the large plane manufacturers and, recalling recent unpleasant experiences with overexpansion, they were anxious that the new facilities be provided without cost to themselves.

Actually, plant expansion was begun on the basis of U.S. and foreign orders and speeded by Roosevelt's call for 50,000 planes. The aircraft manufacturers objected to the limits set on profits by the Vinson-Trammell Act and to the current rate of amortization allowed for tax purposes. During the summer of 1940 the industry almost came to a standstill while Congress debated the issues involved until, finally, with the President's support, the law was liberalized in both respects; even so, the industry preferred British orders, with no profit limits, to U.S. ones. In the building program, various methods of financing were used, all involving some subsidy or guarantee by the government. Expansion was accomplished more rapidly by the airframe companies than by engine factories or those producing propellers, instruments, and other equipment.

The increased emphasis on heavy bombers began a second wave of expansion in the autumn of 1940. Because of the great size and complexity of those planes, current methods of manufacture seemed inadequate. The solution to this problem was found in the pooling of the resources of several big firms, tried first when Consolidated, Douglas, and Ford cooperated on the B-24 program. This system was extended to the B-17 program, with Douglas and Vega aiding the parent Boeing firm, and later in a more complex form to the B-29. Further expansion came with the Victory Program of September 1941. Some of the new factories were located inland to lessen congestion along the two seaboards and to minimize the dangers of air attack, but this trend was not popular with the major companies.

None of the new factories were at work when war began and they were not in full production until 1943, but the rapid growth of facilities had gone forward without disturbing the automotive industry, long considered by some as a sort of ace in the hole. Under the impetus of war itself, further plant expansion of the big firms had been accompanied by a fuller use of the small firms. By the end of 1942, most of the factory space for airframes had been built and some excess capacity had appeared. Some plant expansion still continued for companies manufacturing engines and accessories. In 1944 there were some cutbacks and new expenditures were limited to retooling.

The conversion of the automotive industry, which helped make possible the remarkable production record during the war, came late. It was an obvious possibility that the industry which had developed assembly line methods could use its plants and tools and techniques to

produce airplanes in great quantities. For sufficient reasons, both the aircraft and the automotive industry objected to such suggestions. The Reuther Plan for greater utilization of automotive plants for this purpose was debated widely after its publication in December 1940, but it was not accepted. It was through the manufacture of engines under license to other companies and in new plants that the automobile companies first entered the aircraft field. So long as it was possible to turn out cars and trucks for civilian as well as military use, the large companies continued to do so, and it was the government ban on civilian cars induced by the shortage of materials and labor rather than any desire of their own that turned them to the new task. The real conversion came in 1942. The most important contribution was in the manufacture of engines, in which task the automotive firms surpassed the regular aviation companies, and in making airframe subassemblies and parts. In the assembly of airframes the record was less impressive, even in the highly publicized Ford plant at Willow Run.

The statistical record of aircraft production shows a remarkable growth between 1940 and the peak year of 1944: an increase of about 1,600 per cent in the number of military planes, of about 4,500 per cent in total airframe weight, and of about 2,700 per cent in total horsepower of the engines built. That these records were made with an increase in factory floor space of only 1,200 per cent and of manpower by about 1,600 per cent indicates an appreciable gain in efficiency of operations.

The most conspicuous improvement was the switch from handwork methods to those of mass production. Faced with the need for rapid acceleration of output in 1940, the aircraft industry had wished to freeze designs. In the face of rapid improvement of enemy planes under the impetus of combat, this policy was rejected by the AAF in favor of stabilizing the basic design of a relatively few standard airplanes and adding all subsequent improvements at an AAF modification center, of which ten were eventually in operation. With the degree of stability thus assured, the industry was able to utilize assembly lines in producing engines, airframe parts and subassemblies. Efforts to use the same methods in the production of the whole plane proved less satisfactory.

The prime contractors had not used before 1939 the system of purchasing parts and subassemblies, so common among other industries, and in general they had little liking for it. It was first used by

some of the smaller aviation companies, and did not become widespread until the cutback in the manufacture of civilian goods made it more attractive for other industries to act as subcontractors. This system allowed the use of a pool of unskilled labor, including two groups that until then had been little used by heavy industry, women and Negroes, but it put a heavier burden on management and proved more difficult to schedule accurately than had previous methods.

Some problems the aircraft industry shared with other makers of munitions, others were more peculiarly its own. There was a continuing dearth of management and engineering personnel. An early shortage of machine tools was overcome by 1942. Some materials were in short supply, most importantly aluminum. This situation, blamed by WPB on poor management but by the industry and the AAF on the aluminum producers, persisted until the summer of 1943 and returned early in 1945 with the increase in munitions orders that followed the German Ardennes counteroffensive. Because of its early start in the rearmament program and the location of many new plants in nonindustrial communities, the aircraft industry never faced a comparably severe shortage of unskilled labor. Its labor problems—loss of workers to selective service, rapid turnover, absenteeism, and disputes with management—were all solved tolerably well, in many cases with the active support of the AAF.

The most serious fault with the whole aviation production program was the neglect to provide enough spare engines and parts, and here the AAF was at fault. The shortage stemmed originally from a mistaken use of funds provided in 1939, whereby all appropriations were expended in the purchase of whole planes. The original shortages thus created were magnified by the high priority given Britain in allocations before Pearl Harbor and by the heavy wear and tear on planes in combat, especially in primitive areas. Since quoted production figures were in terms of whole planes, aircraft manufacturers were loath to devote much effort to spare parts, and it required great pressure by the AAF, itself constantly needled by combat theater commands, to overcome the initial handicap.

In spite of errors, the aircraft industry with the aid of the AAF compiled a magnificent record. Those interested in statistics may find them abundantly in this volume. It is sufficient to state here that in the peak month of March 1944, 9,113 military planes were built, a rate of 110,000 per year. If this fell short of the requirements listed in AWPD/42, it was still a sharp rebuttal to those who had considered

President Roosevelt's estimates fantastically impossible. Apparently the United States produced almost as many aircraft as did Britain, the U.S.S.R., Germany, and Japan together, and greatly exceeded them in total airframe weight. This was done by a happy combination of those factors that have made U.S. industry supreme; it is not to detract from the impressiveness of that achievement to remind ourselves that this country, unlike the others, worked out its industrial problems with no interruption from invasion or air bombardment. Such immunity would hardly occur in another war.

To provide logistical support for its combat units the AAF developed during the war a huge organization. The responsibilities of AAF Headquarters in these respects included the procurement, storage, and distribution of countless articles of supply in the United States, channeling those supplies to the combat theaters, and providing properly trained and equipped service units for overseas duty. Supply functions were shared with the Army Service Forces, which handled "common use" articles as the AAF handled articles peculiar to its own needs. Because of the uniqueness of its weapon, the Air Corps had very early taken a heavier logistical responsibility than other Army combat services; during the war, the quasi-autonomous status of the AAF was reflected in an increased power over its own supplies in such common use articles as fuel, ordnance, and communications equipment.

From 1926 until 1942, the Air Corps' logistical responsibilities were vested in the OCAC's Materiel Division, with headquarters at Wright Field and with four major depots distributed over the United States. Conflicts of authority occurred between the Materiel Division and the GHQ Air Force (after 1935) and its successor, the Air Force Combat Command. After much debate and some experimentation, a more unified structure was provided by the establishment in October 1941 of the Air Service Command, and the reorganization of the Army in March 1942 gave the AAF a clearer line of authority in logistical matters. During the first year of the war the ASC operated from Washington, then moved to Patterson Field, Ohio. Its regional structure, involving eventually 11 depots and 238 subdepots, went through a series of changes; after 1944, the system included a number of regional air technical service commands. To supervise the shipment of supplies overseas, the ASC maintained an Atlantic and a Pacific Overseas Air Service Command.

In theory, the AAF's logistical functions were divided between the

Materiel Command, charged with research, development, and procurement; and the Air Service Command, charged with storage, distribution, and maintenance. Inevitably there were areas in which no clear line of jurisdiction could be drawn and after much study the two offices were combined into the Air Technical Service Command in September 1944. Other cases of overlapping authority occurred in relations with the ASF. In these instances it was usually the ASC which was the aggressor, attempting to secure control over certain types of supplies previously classified as common use articles. Though not wholly successful in these efforts, the ASC made sufficient gains to make easier the transition to an independent air force in 1947.

The requirements for aircraft were set by AAF Headquarters in accordance with decisions of the Joint Chiefs of Staff. For other equipment and supplies, requirements were estimated by the ASC and after procurement distributed through channels, usually from factory to depot to subdepot to base, or factory to intransit depot for overseas shipment. Never during the war did the ASC devise an accurate system of calculating requirements. During the early months of the war many combat units suffered grave shortages because of failure to provide spare parts, loss of equipment to enemy action, and lack of transportation. When production and transportation improved, theater supply officers tended to play safe by overstocking and in many areas there were huge surpluses before the war's end. In addition to the normal desire not to get caught short again, other factors contributed to the wasteful handling of supplies. In spite of efforts to simplify stock recording, it was very difficult to keep an accurate inventory in the early part of the war, when there was a great deal of confused evacuation of supplies from the threatened west coast area, when the number of individual articles to be accounted for rose from 80,000 to 500,000, and when the rapidly accumulated stock had to be handled by inadequately trained personnel. It was 1943 before an accurate inventory for the depots existed, and in the meantime requirements were compiled on the basis of "educated guesses" of stock and consumption rates. It was only when production rates and AAF strength leveled off simultaneously in 1944 that the records could be straightened out.

In storage and distribution, the ASC found its facilities swamped at the beginning of the war. The establishment of new depots and subdepots was supplemented by setting up a number of storage depots

near the factories, and eventually by specialized depots, handling only one property class or subclass. In providing organizational equipment, the ASC worked from a table of equipment standard for each type of unit. The issue of such equipment was attended by much confusion during the early months of the war; after experiment with issue at the station of activation and at the first training station, the ASC evolved a system of sending the equipment to the proper theater ahead of the unit, which received it only after arriving at station. After 1943 this system, though not perfect, proved generally satisfactory.

In providing maintenance supplies, the ASC first used a system of automatic supply, with "pack ups" containing the items estimated as required for a given period. Because of the lack of up-to-date stock reporting and the wide fluctuations in demand in an active theater, this method produced too many surpluses and shortages, and was abandoned in the fall of 1943 in favor of a system of specific requisitions which, if also imperfect, at least proved more flexible. War is a wasteful affair and Americans are wasteful people, and it seems doubtful that any economical system of supply could have been devised for so widespread and varied a logistics network.

Policies governing the allocation of aircraft were set at the highest governmental level, but Air Corps leaders served in an advisory capacity as policies were formed and helped administer the programs agreed on. When the fall of France made acute the problems determining the best division of a still-limited output of planes among the chief claimants—the AAF, the Navy, and Great Britain—it was the AAF that took the initiative in promoting the Joint Aircraft Committee, an Anglo-American body which allocated production resources rather than planes. In deliberations of this body and in the ABC strategy conferences in March 1941, President Roosevelt's policy of favoring British combat needs over AAF expansion was adhered to, though in the more pressing need for training planes the AAF had a higher priority, as well as a temporary advantage in heavy bombers, needed to bolster forces in the Pacific.

The extension of lend-lease to the U.S.S.R. in the summer of 1941 put further burdens on U.S. production which could not be solved by the type of informal agreements which had worked well enough between the Americans and British. Both before and after Pearl Harbor, allotments to the Soviets were recited in a series of "Russian protocols" which were considered binding to the extent that produc-

tion allowed and were not subject to readjustment as were the Anglo-American agreements. In all, nearly 15,000 U.S.-built planes were delivered to the Soviets during the war, of which about 4,000 were from Britain's allocations. These aircraft, which included relatively few heavy bombers and large transports, consisted largely of light bombers and fighters, the latter including models which were less popular with American than with Soviet pilots.

When war came, the machinery for cooperation with Britain was elaborated along familiar lines. The Munitions Assignments Committee (Air), a subsidiary of the Munitions Assignments Board, framed schedules which were recommended to the Combined Chiefs of Staff for action. As between the AAF and the Navy, aircraft were allotted by the Joint Chiefs. As between the British and the AAF, the work was done in effect by Chief of Air Staff Sir Charles Portal and General Arnold. The Arnold-Portal agreement of 13 January 1942 was the first of a series of schedules, arrived at by what Arnold called "horse-trading," which attempted to provide the best possible distribution of available aircraft to implement accepted strategy. From Pearl Harbor on, Arnold fought for the principle that, where possible, U.S. planes should be manned by U.S. crews, but in the early part of the war he was forced by higher authority to accept compromise solutions in each agreement. He long maintained that the RAF kept a heavier reserve in planes than needed, but as production moved toward its peak, there was less difficulty in reaching an agreement. After V-E Day, when the AAF had begun to cut back orders to avoid surpluses, Arnold was against assigning to either Britain or Russia the long-range bombers or fighters currently used in the Pacific; the early surrender of Japan before redeployment had got under way avoided any serious debates. Actually, in spite of differences of interest between the using services, negotiations had been carried on in an amicable fashion.

Within the AAF, priorities were set by the A-3 office in Arnold's staff. Until 1944, the bulk of the planes went to equip new units; thereafter, the heaviest charge was for replacements. The normal process for distribution was for the Materiel Command to obtain planes from the factory, ASC to modify and store them, and ATC to ferry them in the various moves from factory to combat units. Of 230,000 planes accepted by the AAF between July 1940 and August 1945 about two-thirds were ferried to their destination, with a loss of

594 in overseas flights and 417 within the United States. Some fighters were flown to Europe, but for the most part these had to be shipped and with the shortage of bottoms that existed through much of the war, delivery in this fashion was a constant problem. Various means were attempted: shipment of planes knocked down and crated in dry cargo ships; use of carriers on special occasions; deck-loading in assembled form on the waist of a tanker; and finally, most satisfactory of all, the development of a specially modified Liberty ship called the ZEC.

In the procurement and training of men the Air Corps played a more important part than in the production of planes. Extensive use was made of such civilian facilities as were available for turning out the crews and technicians needed to man and support the vast number of combat aircraft built, but it was the Air Corps that set all standards of competence, that worked out schedules of classes, that trained or supervised instructors, and that in the final score provided most of the actual instruction—except in primary flight schools and for some technical specialties. The training program involved an expansion as spectacular as that of the production program, as the Air Corps grew from a strength of 20,196 in June 1938 to 2,372,293 in June 1944, and from 11 per cent of the total Army strength to 31 per cent. This growth was made possible by liberal procurement priorities and was marked by a change in training processes that can be compared aptly with the change in production methods from piecework to production line techniques, although in combat crews the variable human factors were too important to allow the breakdown of training into such minutely simplified processes as were basic to the production program.

The prewar training program was excellent if judged by the performance of the men it turned out, but they were carefully selected and highly motivated professionals whose schooling was accompanied by no unseemly rush for time. Pilot training was conducted at Randolph Field, where the largest class before 1939 numbered 246 graduates, and technical training was centered at Chanute Field; the only postgraduate work was at the Air Corps Tactical School at Maxwell Field. The approach of war, and especially the passage of the Selective Service Act in September 1940, changed the procurement basis and brought a severe competition for eligible pilot personnel from Navy and Marine Corps programs, but the Air Corps continued to

enjoy a favorable position: as late as 1943 it was still getting 41 per cent of Army recruits in the two highest brackets as defined by the Army General Classification Test.

In procurement of flying personnel, programs were described in terms of pilots trained per year, a system usually coordinated with the combat group programs. Thus the 24-group program of 1939 called for a goal of 1,200 pilots (and 30,000 technicians) a year; the 41-group program of 1940, 7,000 pilots; the 54-group, 12,500 pilots; the 84-group program, 30,000 pilots and 100,000 technicians. In AWPD/1, which prescribed an ultimate pilot-training goal of 85,000 a year, it was estimated that 10 applicants and 2 school entrants would be required for each pilot who qualified, and that all needed bombardiers and navigators could be provided from eliminated trainees.

Realizing the limited clientele from which it could draw applicants meeting its very high requirements, the Air Force used such inducements as were feasible to attract potential cadets: removal of numerical restrictions and increased pay by Congressional action, use of waivers to bypass the strict physical qualifications, use of a limited number of enlisted men as pilots, training in grade for AUS officers, favorable treatment by draft boards of potential draftees, and help from civic organizations. In spite of pressures to the contrary, the Air Corps before the war held to its policy of requiring two years of college training for flying cadets, rather from the view that such preparation was valuable to the potential officer than necessary for the chauffeur of an airplane.

Recruiting of cadets was a duty of The Adjutant General, performed normally by the OCAC. As the Air Corps' expansion began, the source of supply for cadets was chiefly in the nation's colleges, and methods—and success—varied from one corps area to another. Mobile examining boards proved a successful stimulus to enlistment as did the efforts of various civilian groups, and whatever errors in policy may have been committed, the flow of recruits generally kept up with declared training programs.

The problems of recruiting potential officers for nonrated categories were different. Earlier legal limits on the number of nonflying officers were relaxed, and some effort was made to recruit college-trained candidates for commissions in such fields as engineering, communications, armament, photography, and meteorology. But before the war, classes in those categories were small and, except where

academic standards were unusually high, enough candidates were available from the pool of pilot washouts.

To a remarkable degree, the success of the whole Air Corps program was due to the available supply of reserve officers. Because of budgetary restrictions, only a small proportion of pilots trained at Randolph Field before 1940 had been commissioned in the Regular Army, and only gradually after each new emergency were the laws relaxed to allow for a greater use of those rated reservists who had been trained and commissioned there. The abundance of those officers (and of those trained in wartime) as compared with regulars may be seen in the statistics, which show that the AAF had an officer corps consisting of only 1.3 per cent regulars, as compared with 2.6 per cent for the ASF and 3.5 for the AGF. Conversely, the AAF made relatively little use of National Guard rated officers. The peak officer roll of the AAF of 388,295 included about 40,000 officers originally commissioned in other services. Its ratio of 156 officers to 1,000 enlisted men was appreciably higher than that of the ASF with 97 officers or the AGF with 54.

Traditionally the system for training pilots had been to divide the course into stages—primary, basic, and advanced at Randolph Field—followed by transition to a combat type of plane in a tactical unit. Faced with the problem of expansion in 1938, some Air Corps officers thought it possible simply to multiply the number of "Randolph Fields," but already General Arnold had accepted the idea of mass production and was advocating a plan for use of civilian schools for primary flying and technical training. Through his efforts, nine highly considered civilian schools were persuaded in 1939 to take over contract training at the primary flight level, and by successive increments the number was increased to forty-one by Pearl Harbor and to fifty-six at the peak in May 1943.

Financial arrangements for the training and housing of cadets at contract schools underwent some changes during the war, none radical, and the cost per trainee seems to have been reasonable enough by Air Corps standards. The length of training periods was reduced from an original 1939 schedule of twelve weeks to a 1942 schedule of nine weeks, but this was without prejudice to a continuing course of sixty hours flying time, the reduction resulting from a transfer of the bulk of the ground school work to preflight school. The chief problem in the primary schools was to maintain a supply of competent instruc-

tors, since the civilian pilots used, after refresher courses in Air Corps methods, were continuously subject to recruiting drives by the ATC and Navy and to the zealous attentions of local draft boards.

The use of civilian help for technical training proceeded somewhat more slowly, with seven schools under contract in 1939 and fifteen when war began, at which time there were about four students in AAF schools for each one under civilian tutelage. Thereafter expansion was more rapid as the AAF turned to the universities, airline companies, and factories for technical training of officer candidates and enlisted men. But the great bulk of trainees were taught by the AAF itself in schools established before and after the beginning of war. The new programs included more specialized training for such previously neglected crew members as bombardiers, navigators, and flexible gunners, though as war began there was still a deficiency in each of these categories. The great weakness in the whole training program was a lack of qualified instructors and of actual combat experience. The latter want was lessened somewhat by information supplied by the British and by AAF officers who had served as observers during the Battle of Britain. The organizational structure had been strengthened somewhat by the establishment of the Technical Training Command (March 1941) and the Flying Training Command (January 1942), and by a more precise allocation of duties among the continental air forces which gave to the First and Fourth a primary duty of national defense, to the Second and Third a primary duty of training.

The increased training rates for aircrew and ground specialists that were established after Pearl Harbor rendered inadequate previous methods of procurement. Standards for pilot trainees were liberalized somewhat, and an examination was substituted for the two years of college requirement. The number of cadet examining boards was increased to more than 200 and travelling boards in trailers toured outlying areas. To tap manpower sources as yet untouched by the draft, the minimum age was lowered from twenty to eighteen years. These procedures, accompanied by a great deal of publicity, greatly stimulated enlistment, and for several confused months those inducted as aviation cadets greatly exceeded accommodations. With the establishment of regular quotas to fill scheduled classes, some order was restored, but in the face of competition from other recruiting programs, particularly of the Navy and Marine Corps, the AAF felt it neces-

sary to devise some method by which it could meet its rising needs and in the meantime maintain a pool of 50,000 candidates.

A solution was found in the Air Corps Enlisted Reserve (ACER), established in April 1942, which allowed a candidate to enlist with expectation of eventual call to duty as an aviation cadet, spending the interim as an enlisted man, or at his civilian job, or in college where he might be given a deferment. During the spring a concerted recruiting campaign was conducted which aimed especially at the colleges, and by fall the desired pool had been built up, with enlistments running about 3,000 a month over the 10,000 called up.

The ACER had provided for a small number of cadets to train for commissions in various ground specialties. The educational standards were higher than those for aircrew trainees and the physical requirements were lower; generally the examining boards misunderstood or failed to observe instructions and in most of these categories accepted too many candidates. There were other sources of supply than the ACER—aircrew eliminees, graduates of enlisted men's technical schools, and officers training in grade—and it became necessary to close enlistment in some specialties as early as September 1942 and in all by March 1944.

War Department policy required a maximum use of civilian workers in depots and subdepots, and the task of recruiting and training the 300,000 persons eventually so used added to the AAF's burdens. It was difficult to get and keep technicians of various sorts since better paying factory jobs were plentiful. Several types of training were used for trainees retained on a minimum wage: civilian contract schools, government-operated "off reservation" schools, post schools, and factory schools. Increasing use of women in mechanical as well as clerical jobs brought their number to 46 per cent of the total force by June 1944. Estimates of their efficiency as compared to male employees have shown as wide a variance as might be expected in a battle of the sexes where few care to be neutral, but the arguments seem not wholly material since the women did a great deal of valuable work when there was no one else to call on. A smaller source of labor was found in the physically handicapped, who needed more careful assignment procedures but whose record on appropriate tasks—and they were surprisingly diversified—was most heartening.

A problem of special importance to the training program was to provide instructors for constantly growing classes. For AAF flying

schools, instructors could be provided from graduates of the central instructors school, and the chief concerns were to maintain a proper ratio between instructors and students and to avoid excessive turnover of instructors through assignment to combat duty. There was more difficulty in the contract primary schools where civilian flying instructors were constantly lost to the Navy because of the War Department objection to granting direct commissions to civilians.

To take over ground-school instruction, once given by rated officers who could no longer be spared from more pressing duties, AAF schools depended at first on local resources—enlisted men, eliminees, civil service personnel, and men with some experience as teachers but little knowledge of the subject matter in question. In 1942 the training centers turned to the colleges with a program of direct commissions for qualified instructors. Some 500 college teachers were thus obtained by a board recruiting for the Gulf Coast Training Command and later 1,000 more were split between the three flying training commands. Promises of some of the recruiting officers were somewhat overoptimistic; this at any rate seems to be a judgment validated by the experience of a number of our authors and of one of the editors, and by the reminiscences of a wide sampling of the academic profession today. The subject matter assigned to many instructors was unfamiliar but simple enough to be superficially mastered in a short time and most schools had some sort of in-service training. By 1943 most ground-school instructors were in uniform, usually as officers, though in radio code there were some enlisted men and in the various Technical Training Command schools a great many.

As the manpower shortage became more severe, the AAF suffered two serious blows to its enlistment program: the lowering of the draft age to eighteen in November 1942 and the closing of voluntary enlistments in the following month. In theory this meant that the AAF would get its aircrew trainees from a quota established by the War Department, but the allotment of qualified candidates soon fell in arrears and it was only the ACER pool—long the object of outside criticism—that served as a protective cushion. The initial age for the ACER was reduced to seventeen years with much legal difficulty and without the anticipated results. Some easement in a tight situation was afforded by a system of voluntary induction and by increased use of enlisted men as potential cadets. By October 1943 the crisis was over; successive cutbacks in the pilot-training programs created long wait-

ing lists, with consequent ill effects on morale, and at the same time allowed longer training periods. Early in 1944 the AAF ceased procurement of cadets from the AGF and ASF and from voluntary inductees, and after V-E Day pilot training was reduced to 1,000 a year; similar cuts had already been made in the bombardier and navigator programs.

Procurement of Negro airmen presented peculiar difficulties. Army policy was to use Negroes in the same proportion as they were found in the total U.S. population, a figure calculated at 10.6 per cent. Actually, this was never done. On the Army General Classification Test an inordinate number of Negroes scored in the two lowest categories, whereas by War Department policy the AAF had been given more than its share of men scoring in the two highest brackets; hence relatively few Negroes could qualify for flying or technical schools. Army policy was to use Negroes in segregated units with Negro officers "where possible," but whereas the 1944 troop basis for the AAF called for 156 officers per 1,000 men, Negro officers numbered only 110 per 1,000 colored troops. Relatively few Negroes received flying training and ratings. Most Negroes served in supporting or service units as "basics." A significantly smaller proportion of Negroes than of whites were sent to overseas stations.

The section on Negroes in this volume has been deliberately limited by the editors to a statement of the main problems and of attempted solutions. The whole subject of Negroes in the armed services is important enough to deserve a more careful study than seemed appropriate in a treatment of recruitment and training which was organized along functional lines that in theory at least had no connection with racial or ethnic considerations. From the summary account presented the editors have formed the opinion—which is not an official one—that the policy of segregation failed in its purpose of providing Negro units equal to similar white units; that there was some justification for the AAF's refusal during wartime to accept responsibility for a social reform not yet agreed on by the nation; and that the progress of integration since the war has shown that there was nothing peculiarly inherent in the airman's disposition that determined the AAF's policy between 1939 and 1945.

The whole history of recruitment during the war, indeed, merits further investigation. The conflict between the basic assumptions of selective service and the idea that volunteering was essential to an

elite corps was inevitable, though generally it could be resolved by compromise between men of good sense and will. The different methods used by the several services to recruit officer material encouraged sharper competition than was good and the habit of holding large pools of potential officer material against some unpredictable emergency worked a handicap on some valuable but less highly publicized services, to say nothing of the frustration it brought to the individuals concerned.

To facilitate the transition from civilian to military life, the Army had long favored a brief period of orientation and of indoctrination in those attitudes and skills which were fundamental to soldiers of whatever arm or service. As the need for specialized training increased, the basic program was contracted during emergency periods, especially in the Air Corps where technical jobs were so numerous; but the use of a separate station for receiving, processing, training, and distributing recruits remained standard. This began soon after the adoption of selective service in 1940 with a single Air Corps reception center at Jefferson Barracks, Missouri; eventually the program grew to include, at peak strength, seven basic training centers. Without a clear directive or proper resources, the Jefferson Barracks staff worked out a four-week program that was later lengthened to eight weeks, when it became an unofficial model for other schools. Much attention was given to physical conditioning, generally thought to have been well done, and to the School of the Soldier, done without arms and without great success by infantry standards. Eventually, as a result of complaints from combat theaters, more attention was given to the use of weapons and to survival training.

Classification began at the Army reception centers, where the recruit took certain tests and received his qualification card before being assigned to a particular service, and continued at the basic training center with more tests and interviews on the basis of which he was assigned to a job or, more frequently, to a school for further training. Aptitudes, as measured by the tests, and personal inclinations were consulted in making assignments, but the need to fill certain quotas at any given time was often the deciding factor, at least until mid-1943.

Testing for selection and classification of aircrew trainees had begun on an experimental basis in 1941 and was extended to cover all candidates immediately after war began. Three classification centers were established in the spring of 1942 to process, classify, and house

cadets before their call to a class. There the qualifying test used in lieu of college credits was administered. Then the cadet received the "classification battery" of psychological and psychomotor tests designed to eliminate the unfit and determine the best position (pilot, bombardier, navigator) for the fit. The medical examination was stiff, though some waivers were allowed, and a psychiatric test proved a valuable time saver. All in all, the tests stood up well as predictors of success, eliminated many potential failures, and gave a useful guide for the assignment of cadets to the proper specialty, though both tests and personal inclinations sometimes had to bow before the inexorable logic of the quotas.

Individual training of aircrew members was carried on in the many airfields belonging to the three regional training centers and under the general supervision first of the Flying Training Command, then (from 1943) of the Training Command. For pilots the traditional three-stage system of prewar times was continued, but to compensate for accelerated programs designed for tremendous classes a preflight stage was added early in 1942, with four large schools, three of which were located adjacent to the classification center pools. Separate training for pilots and nonpilots was the rule until 1944, when all preflight work was concentrated at the San Antonio Aviation Cadet Center. The programs grew in length from an original four weeks to nine weeks in 1942 and ten in 1944. Originally the main stress was on military and physical training, but there was a general strengthening of the academic program designed to supplement the trainee's civilian education: curricula were improved and standardized, teaching aids devised, and the quality of teaching improved by the addition of instructors commissioned directly from the colleges. The aircrew college training program of 1943–44 was ostensibly designed to extend this preflight training into civilian schools, but its real purpose was to protect a pool of potential cadets, a ruse which was readily diagnosed and criticized by the Selective Service System and the War Manpower Commission. The college program was never successful in its training function; after its abolition, candidates awaiting assignment to the steadily diminishing preflight classes were held by assignment to on-the-job instruction in maintenance or even clerical jobs on airfields. This gradual approach to the status of enlisted men was hard on morale, and the high motivation that had characterized cadets at preflight schools in the first two years of the war fell appreciably.

The three-stage (primary, basic, advanced) system of instruction at Randolph Field before the war had produced in twelve months excellent pilots who were also competent junior officers. In 1939, the period was cut to ten months and in 1940 to seven. After Pearl Harbor, classes at preflight and each subsequent stage ran nine weeks until 1944 when they were extended to ten. Successful candidates received commissions after graduation from advanced flying schools; later they underwent transition training in combat planes and learned to operate as a combat team. In all, the whole period of instruction before combat might be well over a year. As compared with the old prewar program, the course through advanced school had lost somewhat in the hours of actual flying, but the main saving in time was at the expense of the military training. Even under the accelerated program the American cadet got much more experience in the air than the German or Japanese, and toward the end of the war the very heavy advantage in that respect was graphically shown in the results of air combats.

Each successive stage of flying training was marked by the use of a more powerful aircraft and the performance of more complicated tasks. Usually the courses were divided into several set phases with performance checks at each. There was some experimentation with the use of different instructors for each phase but the "all through" system in which a single instructor carried a very few students through a complete stage was almost universal. There was a trend toward standardizing ground-school and flight training through the establishment of central instructors schools and the use of uniform manuals and training aids. In the matter of grading performance in the air, the judgment of instructors and supervisors unavoidably included many subjective elements which prohibited the establishment of uniform standards. Furthermore, directives of AAF Headquarters fluctuated between a stress on quality and on quantity of pilots according to the shifting strategic situation and the quota of cadets, and these changes in attitude were reflected in the standards for graduation. There were thus no fixed rates for eliminees but rather a proportion that varied with the quality of a particular class and instructor and with the current demand from Washington. Between July 1939 and August 1945 the advanced flying schools graduated 193,440 pilots. During the same time about 124,000 cadets, roughly two out of five matriculating, had washed out, most of them in primary and fewest in advanced.

The Air Corps had had less experience in training bombardiers and navigators in the prewar years; such instruction as had been offered was informal, on-the-job teaching of individuals. Separate schools with regularized instruction for the two specialties were begun in 1941. The original twelve-week course at the bombardier schools was lengthened to eighteen weeks in 1943 and eventually to twenty-four. The ratio of ground to air instruction time was about four to one. The heavy use of pilot washouts in this specialty created morale problems which the AAF attempted to mitigate by a high-powered publicity campaign. Instruction for navigation cadets began in a contract school run by Pan American Airways and was extended to include four AAF schools. The instruction period grew by increments from fifteen to twenty weeks, with about 500 hours of ground school and 100 hours of flight. Generally, navigation cadets were better selected and more highly motivated than the bombardiers, but because of the stiffer requirements elimination rates for the former were about 20 per cent as against 12 per cent for the latter. In both courses improvement came as equipment grew more plentiful and as the central instructors school for each specialty made methods more nearly uniform. For a while some candidates were trained in both schools, usually with an abbreviated course in one or the other, to qualify as navigator-bombardiers.

There were other less common rated specialties for which schools had to be established—that for B-29 flight engineers, for example, or for radar observers. Enrollment in the seven flexible gunnery schools was much heavier, for the six-week course they offered was required for other members of a bomber crew besides the "career gunners." Total graduates included 297,000, with a 12 per cent washout rate. Methods of instruction improved, but none of the many devices or techniques used could offer an apt simulation to combat situations, and complaints from the theaters on marksmanship continued throughout the war.

As the number of authorized combat units increased by successive increments, the old regular Air Corps units found themselves unable either to absorb the flow of graduates from the new flying schools or to provide sufficient cadres for the new units being formed. AAF observers brought back from Britain in 1941 enthusiastic reports of methods used by the RAF in forming and training new combat units and combat crews, and like so many other RAF procedures, those methods were borrowed and adapted to AAF conditions. The opera-

tional training unit (OTU) program involved the use of an oversized parent group to provide cadres for what were called, in a somewhat mixed metaphor, satellite groups. Graduates from the schools were used to man the satellites and to restore the parent after each loss of a cadre. The system, developed during the early months of the war, was in full swing by 1943. Cadre leaders were given an intensive thirty-day course at the AAF School of Applied Tactics at Orlando, after which they returned to direct the individual and unit training of the new group. Generally six months were required from the original assignment of the cadre to readiness for combat. Some additional training for local conditions might be required in the theater, but the OTU had made a combat team from a group of individuals assigned at random.

After May 1943 the continental air forces used also the replacement training unit (RTU), a substitute for the older custom of drawing replacements from organized units or instructional staffs in the United States. To train individual combat pilots or crews in larger teams, the RTU was formed as an overstrength group from which replacements were constantly transferred while new school graduates came in, or as a provisional group under a parent unit, the former being dissolved into a replacement pool at the end of training. By the end of 1943, when practically all groups except those for B-29's had been organized, the RTU replaced the OTU for all other types. Eventually the RTU's merged with their air base complements to form combat crew training stations, which provided a more realistic training for overseas assignments.

Although there was some diversification among the several continental air forces, in general the First and Fourth specialized in fighter training, the Second in heavy and very heavy bombardment and I Troop Carrier Command in transport. Because of the size of the crew, the complexity of the plane, and the nature of AAF doctrine, the most important of these programs was for heavy and very heavy bombers. The B-29 program was unique in being under the combined direction of AAF Headquarters, the Second Air Force, and Training Command. Most of its pilots (though not co-pilots) were men with hundreds of hours of flying in multiengine planes, and many crew members were experienced.

The OTU-RTU system was handicapped by the customary shortages in personnel and equipment and, until the reorganization of AAF

Headquarters in March 1943, by too much interference by Washington. In reply to complaints from overseas, the continental air forces began specialized training for each theater, using in 1944 and 1945 small units on leave from the theater as a cadre for replacements assigned thereto. Special problems arose in training reconnaissance and troop carrier units, for which there was no substantial prewar experience.

Although the preparation of combat crews was the most eager concern of the training establishment, the training of ground technicians and service personnel was a heavier charge in terms of sheer numbers of graduates. In the AAF there were seven men on the ground for each one who flew and four of them were rated as technicians; 700,000 graduated from courses in maintenance alone during the period 1939–45. Chief responsibility for the vast and variegated programs lay with the Technical Training Command and its successor the Training Command; but the task was shared by ATC, the continental air forces, and the parent organization of members of Arms and Services with the AAF. Three types of schools were used: those run by the AAF, civilian-operated contract schools, and factory schools for specialists on articles produced by that company.

The basic airplane mechanics course, with a term of 112 days, soon became standardized. Some experiments in specializing on a particular kind of airplane were tried, then abandoned in favor of 76 days of general instruction and 36 of specialization on a single type. Besides this basic course, there were schools that carried the trainee on to become an expert mechanic on electric equipment, power plants, instruments, and hydraulic systems. Schools for auxiliary specialists included those for welders, machinists, sheet metal workers, and parachute riggers. In addition to these schools, most of whose graduates came under control of an engineering officer, there were various fields for which instruction was provided in both operation and maintenance: communications, radar, armament, aerial photography, weather, and aviation medicine. In most cases courses for enlisted men were given in AAF or contract schools, those leading toward a commission by contract with some college or university.

Complaints by General Arnold that instruction was too theoretical led to a radical experiment by the Technical Training Command in 1942. Classes were put on a seven-day-week, twenty-four-hour-day schedule. All lecturing, all reading, all written exams were to be

abolished and all instruction was to be by demonstration and imitation. Whatever virtues the system may have had, it proved impossible to administer with the existing staff of instructors, though its main principle of strict adherence to the practical aspects of a subject was usually followed.

The ground echelons of combat units, made up of graduates of the various technical schools, were trained as teams under the supervision of the continental air forces and I Troop Carrier Command. The training was given at the OTU along with that of the flight echelon, and a cadre system was used similar to that for the flyers. Service and depot groups were put together by the ASC, sometimes on bases operated by the continental air forces, in which case there was often a wasteful duplication of men with both a permanent and a student unit existing at the same station.

In addition to the more or less standard schools training aircrews and ground technicians, the AAF provided training for a wide variety of other specialists. ATC, for instance, was faced with the need for pilots familiar with a wider variety of airplane types than was common among combat pilots. Originally ATC was able to enlist a number of civilian pilots, bring them up to the level of service pilots, and then commission them. Later the ATC had to depend on graduates of the regular schools, and so in 1942 began the use of OTU's, of which there were eventually four. Responsibility was vested in the Ferrying Division and emphasis was placed on checking out the pilots on a wide variety of planes, but the course was intended for transport pilots as well as those delivering aircraft. By 1944 the courses had been lengthened to as much as eighteen weeks and had shown marked improvement with specialization for various plane types at the several OTU's, one being devoted exclusively to prospective crews for the Hump airline in India-China. To supplement the supply of male pilots available for ferrying, a project for using experienced women pilots was begun with the Women's Auxiliary Ferrying Squadron in September 1942. Shortly thereafter a more ambitious plan to train women pilots in greater numbers and for more diversified tasks resulted in the establishment of the Women Airforce Service Pilots. Instruction according to AAF methods with necessary modifications continued until the disbanding of the WASP's in late 1944. Whether under the existing manpower situation, realistically estimated, the results of this

experiment justified the effort required to maintain the special training establishment might make an interesting topic for study.

To release as many rated officers as possible from routine administrative jobs, the Technical Training Command established an officers' candidate school at Miami Beach in February 1942. It was moved to San Antonio in June 1944 and again to Maxwell Field a year later. The school drew its candidates chiefly from eliminated flight cadets and enlisted personnel and, with a waiting list of each far greater than the quotas allowed, OCS might have selected a highly qualified student body but for errors in assignments. The school had a reputation for being "tough," apparently exaggerated because of incorrect rumors as to the rate of elimination. Other complaints were better founded. In the academic section too little was taught about too many subjects in too short a time (twelve weeks). The military phase, consisting almost entirely of close order drill and ceremonies, was stressed at the expense of the administrative training for which the school had been founded. An unsuccessful effort to imitate the West Point class system brought criticism, especially from adult officer candidates who had little liking for adolescent forms of hazing. Classroom instruction was uninspired. It was little better at the adjacent officers' training school where specialists commissioned directly from civilian life were given six weeks of military orientation. For the student officers, aged usually between thirty and forty-five years, the drill and physical training were less exacting, but the academic program was as superficial and as dull.

By contrast, the varied instruction given at the AAF School of Applied Tactics at Orlando drew heavily on the experience of men freshly returned from combat assignments who, whatever their pedagogical skill, had an impressive fund of useful information. The wide range of student ranks—from major generals to enlisted men—and the deliberate slighting of the more formal aspects of military courtesy must have contributed as much to the unique character of AAFSAT as did the unconventional nature of the tactical problems studied and taught there.

Finally, it should be recalled that the AAF trained in its flying or technical schools a great number of foreign nationals. Some 31 nations were represented among the 21,000 foreign students who enrolled in AAF schools, but more than half were British and they, with the French, Chinese, Brazilians, Netherlanders, and Mexicans—in that

order—made up all but a handful of trainees. In some cases the service rendered was for diplomatic rather than military reasons and indeed, except in the case of a few of the countries that sent large quotas, the immediate results could hardly have repaid the not inconsiderable efforts involved.

The length of the section of this volume devoted to the training program is a reliable index of the importance assigned thereto by the editors and contributors. It is possible that they have here exhibited a more critical attitude than in dealing with other stateside activities of the AAF. If so, it has been because of their own professional training as teachers and their wartime experiences in schools which differed so sharply from their civilian colleges in curricula, methods, and standards. Probably the AAF schools would have been improved by a more liberal use of experienced educators at key administrative positions (as they were used for instructors) rather than depending on a random assignment of reserve officers who in civilian life had been lawyers, insurance agents, or car salesmen. Yet in last analysis most of the obvious faults in the schools were those that stemmed from an over-rapid growth and were hardly avoidable. On the positive side, the chapters in question show that the AAF did recruit and train the world's largest air force; the over-all soundness of the methods used may be seen in the air victory.

Before Pearl Harbor, both German and Japanese pilots were receiving more training before assignment to units than were those of the U.S. Air Corps. In the last year of the war, when AAF pilots were showing a marked superiority over their Luftwaffe opponents, the training of the Americans included an average of about 360 flying hours; of the Germans, about 110. In terms of training in combat models, the discrepancy was even greater. In the same period, the Japanese were committing *kamikaze* pilots to combat with as little as 70 flying hours. Some idea of the fashion in which the AAF average of 360 hours was accumulated may be derived from the present volume, supplemented by sections from the pertinent combat narratives that deal with theater training programs. The editors have thought it useful to give here an account of one pilot's career, drawn from his 201 File, to document the AAF's emphasis on thorough and on-going flying training. To illustrate as many phases of the program as possible, the editors present the case of Capt. Frederick C. Bock,* whose

* For Captain Bock's part in the atomic bombing of Nagasaki, see Vol. V, 719–20.

period of service was about coterminous with the war training program.

Frederick C. Bock, born 1918, was graduated from the University of Chicago in the spring of 1939. He stayed on for a year of graduate work in philosophy, then went to work in a wholesale grocery. In March 1941 he applied for an appointment as aviation cadet and was accepted by a traveling flying cadet examining board at Grand Rapids, Michigan. This gave him deferment from the draft and Bock returned to his university to await his call from the Air Corps, meanwhile receiving some flight instruction—enough to have soloed—from the CAA. He was enlisted at Fort Custer, Michigan, on 10 July 1941 and sent to Fort Ord, California, for his final physical check. He did his primary training at a contract school at Santa Maria, California, and his basic at Moffett Field, where he returned from his last solo flight on 7 December to learn of the Japanese attack on Pearl Harbor. Each stage had lasted ten weeks, but in the emergency his class in the advanced school at Stockton Air Base was accelerated, so that 2d Lt. Bock received his wings and commission on 23 February 1942, almost a year from the date his application was accepted. In the meanwhile, he had amassed about 200 hours of flying time—60 hours in a PT-13 at primary, 70 in a BT-13 at basic, and 75 in an AT-6 at advanced.

There being as yet no OTU's, Bock was assigned to the AFCC and sent to Pendleton Field, Oregon, where he received transition training in a B-17 and was rated as co-pilot in the 34th Bombardment Group (H); his operations officer was Maj. Curtis E. Le May. After six weeks Bock went to Morrison Field, Florida, and thence to Karachi, India, where he arrived on 5 May 1942 and was assigned as a replacement to the 7th Bombardment Group (H). There was more training, mostly in B-17's and then in B-24's as the 7th Group was re-equipped about October. When he flew with his 436th Squadron in the first China strike with heavy bombers, on the 21st, Bock had flown in training and ferrying between 450 and 500 hours, well over half of the time in combat planes. He was rated first pilot in December.

After eleven months of combat, Bock was rotated to the States, being assigned in September 1943 to the 9th Bombardment Group (H) at AAFTAC, where his unit was engaged in developing and teaching bombardment tactics. This assignment lasted until February 1944

when he volunteered for the B-29 program and was transferred to the Second Air Force, then in charge of VHB training. When he began his transition to the B-29 in April, he had a total of over 1,150 flying hours. The new training went slowly for want of sufficient B-29's, but his squadron, the 393d Bombardment (VHB), had almost completed the normal OTU program when in September it was chosen as the atomic-bomb unit and moved from Fairmount Air Field, Nebraska, to Wendover Field, Utah. The intensive training that followed omitted some of the regular features but included a tour of temporary duty at Batista Field, Cuba, whence long overwater simulated missions were flown, and bombardment practice in Utah, with bombs having ballistics characteristics similar to those of the atomic bomb.

In June 1945 the 393d flew its specially modified B-29's to Tinian. There Bock and his crew, with others in the squadron, took a seven-day theater orientation course and then three weeks of combat flight training which included half-a-dozen practice missions with some bombing of by-passed Japanese islands. Then occurred several strikes against targets in the main islands with 10,000-pound bombs; these were regular combat missions carried out by small flights of two or three planes, but their purpose was further training for the real mission rather than to accomplish any significant destruction. The payoff came on 9 August when Bock piloted one of the B-29's on the atomic strike against Nagasaki. His last mission was another go with a 10,000-pounder on the 14th; he learned of the cessation of hostilities that day, as he had of their beginning, on his return from a flight which was essentially a part of a training program, though conducted under very different circumstances. In November, Captain Bock was relieved from duty with his squadron at Roswell Air Field, New Mexico. He then had logged 1,863 hours in flight and in spite of his having had two very active tours of combat duty, well more than half of that time had been devoted to training, either of himself and his crew or of others.

The chapters on training in this volume have been written by Thomas H. Greer and Arthur R. Kooker, both of whom were actively identified with the AAF training program during the war. Alfred Goldberg has brought to his study of equipment and logistical services a long experience with air service organizations in the European

Theater of Operations. Frank Futrell's experience as historical officer included assignments both to the AAF School of Applied Tactics and to the Far East Air Forces. William A. Goss had a long tour of duty with the Fourth Air Force during the war, and after the termination of hostilities he was reassigned to AAF Headquarters. P. Alan Bliss undertook his study of air defense while a member of the AAF Historical Division.

The editors began their work on this volume at a time when Col. Wilfred J. Paul continued to serve, as he had for several years past, as Director of the Research Studies Institute. They regret that the work could not be completed before Colonel Paul's retirement from active duty on 31 August 1954, for they have come to regard each published volume in this series as being in some measure an acknowledgment of his very great help in making possible a history of the AAF. That the series now requires only one more volume for completion is largely owing to the genial and ever helpful guidance he has given the project from its beginning.

We are happy to acknowledge the many courtesies of his successor, Brig. Gen. Clinton W. Davies, Director of the Research Studies Institute, Air University. Among the members of General Davies' staff we are most heavily indebted to Dr. Albert F. Simpson, Chief of the USAF Historical Division, and to Lt. Col. Eldon W. Downs and Mr. Joseph W. Angell, Jr.; Dr. Ernest S. Gohn, Lt. Paul S. Guinn, Jr., Dr. Edward C. Williamson, and Mr. James L. Daniels, Jr., have been especially helpful in the editorial assistance they have provided. Lieutenant Guinn has prepared the glossary and the index. Mrs. Juliette A. Hennessy compiled the appendix listing the wartime assignments of key AAF personnel. The charts have been done by Mr. Z. F. Shelton, Jr. Donald L. Zoll, on loan from the Directorate of Intelligence, contributed importantly to the collection of the information on which Section II is based. Footnotes and other references in the text carry individual acknowledgment of our indebtedness to those who have so generously permitted us to draw upon their wartime experience for the purpose of clearing up obscurities in the records. For a variety of helpful acts our thanks go also to other members of the USAF Historical Division, and especially to Miss Marguerite K. Kennedy and her associates in the Archives Branch; Miss Sara Venable, Mrs. Molly O. Keever, and Mrs. Margie McCar-

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Once more, the pictures have been made available through the courtesy of the Photographic Records and Services Division, Headquarters, USAF. And once again, all of us are indebted for the friendliest cooperation of Dr. Kent Roberts Greenfield and his colleagues of the Army's historical division.

WESLEY FRANK CRAVEN
JAMES LEA CATE

CHICAGO, ILLINOIS
10 December 1954

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MAJ. GEN. HENRY H. ARNOLD, CHIEF OF THE ARMY AIR FORCES, AND STAFF, 1941

Left to right: Lt. Col. Edgar P. Sorenson, Lt. Col. Harold L. George, Brig. Gen. Carl Spaatz, Maj. Gen. Arnold, Maj. Haywood S. Hansell, Jr., Brig. Gen. Martin F. Scanlon, Lt. Col. Arthur W. Vanaman

SECTION I

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THE ORGANIZATION AND ITS RESPONSIBILITIES

CHAPTER 1

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ORIGINS OF THE ARMY AIR FORCES

IN MILITARY annals revolutionary changes are rare indeed, but no one can dispute the radical influence of the airplane upon the composition and organization of American military forces during World War II. A sharp reversal in official attitudes toward the role of aviation in U.S. defenses had been foretold as early as the fall of 1938, when defensive measures instituted by President Roosevelt gave the heaviest emphasis to the production of aircraft. By 1941 the Air Corps already had taken important steps toward a new autonomy that would develop into virtual independence for the Army Air Forces, first established in June of that same year. The postwar decision in favor of a separate air force merely gave legal sanction to a decision shaped by the experience of the war years.

When President Roosevelt inaugurated the new defense program in 1938, policy had been guided for four years by the findings of a special board headed by former Secretary of War Newton D. Baker. Called into existence in 1934 for a final and authoritative review of the repeatedly agitated question of an independent air force,[1] the Baker Board ruled once again that the air arm should remain "a homogeneous part of the Army, under General Staff control." The final report declared: "The ideas that aviation, acting alone, can control sea lanes, or defend the coast, or produce decisive results in any other general mission contemplated under our policy are all visionary, as is the idea that a very large and independent air force is necessary to defend our country against air attack."[2]

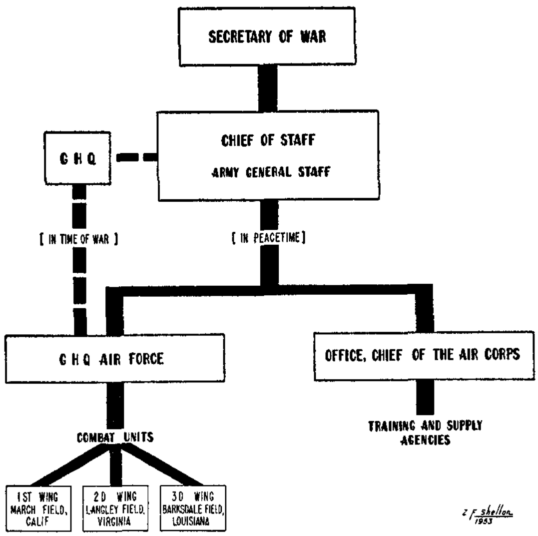
Taken alone, this summation offered no encouragement whatsoever to the Air Corps. The board, however, had made one concession to the airman's point of view by indorsing the recommendation of an Army board in the preceding year for the establishment of a General Head-

quarters (GHQ) Air Force to combine under a single command all of the Air Corps' combat elements. The new organization, which was activated in 1935, gots its designation from current plans for the command of Army field forces in the event of war. It was assumed that the Chief of Staff on the outbreak of hostilities would take active command of the field forces through such a GHQ as had served Pershing in France during the last war.[3] Since this GHQ would be the ranking Army command, its air force would enjoy the advantage of close identification with the highest echelon. Whether GHQ fought in direct defense of our own shores or once more at the head of an expeditionary force, as in 1918, the GHQ Air Force could expect to control in large measure the employment of the aircraft assigned to it, and this was a point of no small importance to all airmen. There were many grounds for their objection to the general proposition that an air force existed only for the support of other forces, but none was more important than the simple fact that this assumption promised to leave the control of aviation in the hands of ground officers who had little understanding of the weapon they employed. The establishment of a GHQ Air Force five years before GHQ itself was activated in 1940 lent a certain confusion to the Army's organization; more especially, it imposed upon the structure of the Army's air element a dichotomy that proved inimical to effective administration until the scheme was finally abandoned in the spring of 1942. But this disadvantage became more apparent in the light of experience than it seems to have been in 1935.

At that time the Air Corps quite evidently had elected to make the best of the opportunities offered by a GHQ Air Force without renewed protest on the larger issue. The decision reflected no doubt a sensible adjustment to the lessons of experience. Although eight separate bills providing for a department of aeronautics had been introduced in Congress between 1916 and 1920,[4] the Reorganization Act of 1920 had gone no further than to recognize the Air Service as a combatant branch of the Army. Billy Mitchell's colorful campaign through succeeding years had won nothing more than minor concessions in the Air Corps Act of 1926. Now, for the third time, the issue had been put to a test and the airmen again had lost. Perhaps, too, it had come to be recognized that the contest was no simple fight between the top brass and farsighted subordinates, as Mitchell had undertaken to dramatize the debate. The airplane, as airmen were fond of reminding

themselves, was primarily an offensive weapon, and the national attitude was one of defense, so much so that little tolerance existed even for the age-old maxim that the best defensive move may be to take the offensive. In rejecting Wilson's League of Nations the people of the United States had adopted a negative policy, and even the efforts subsequently made to establish positive elements of policy—as in the disarmament conferences and the Kellogg-Briand Pact of 1928—served

THE ARMY AIR ARM
(LATE 1935)



chiefly to reinforce a popular assumption that America might be an island of peace in a sea of world conflict. Nowhere did that hope find stronger expression than in the Neutrality Act of 1935, which recorded the dominant view of the American people in the year after the Baker Board had reported.

A more important argument for acquiescence in the decision of that board seems to have come from circumstances linking its recommendation of a GHQ Air Force with the very hopeful opportunities of a new mission recently given the Air Corps. In January 1931 the MacArthur-Pratt agreement between the Army and the Navy had established, or so it was thought, the right of Army aviation to participate to the full extent of its capacities in coastal defense. Plans sub-

sequently drawn by the Air Corps emphasized the need for long-range planes to extend the reach of offshore reconnaissance, to permit rapid reinforcement of outlying bases without dependence upon intermediate facilities, and to provide striking forces that might deny an enemy the advantage of a close approach to our own coasts. By 1934 War Department approval had been given for the development of bombers with ranges as high as 5,000 miles, and contracts had been let as early as 1933 for shorter-legged planes that would still be capable of performances greatly exceeding those of current models. Work on one of these—the later B-17—had gone so far that the first prototype was flown in July 1935.* To put the point briefly, the Air Corps at the time of the Baker report was well on the way toward achievement of a long-cherished ambition to build a truly big bomber.

The big bomber, combining longer range with a heavier lethal load, promised to demonstrate, as could no lesser plane, the fundamental propositions on which the airman based his claims: that the air is an area of military conflict no less distinct than the land and the sea, and that it offers opportunities for inflicting destruction upon an enemy which do not necessarily depend upon the fortunes of war on the land or the sea. With the GHQ Air Force serving to concentrate control of the new weapon in a single air command, it could be anticipated that the Air Corps might soon have a striking force of great power and flexibility. It is not without significance that this prospect was accompanied by a new emphasis in the Air Corps on the doctrines of strategic bombardment.† Nor is it without interest that Arnold, despite the disappointments experienced in the years immediately after 1935, could look back on that year—a year which produced the B-17 in the United States and the Manchester bomber in England—as the turning point in the history of air power. In retrospect, he felt inclined to argue that the autonomy denied the Air Corps in 1934 would have made little significant difference. The RAF "had had its own ministry, its own uniform, . . . its own budget," but only with the development of the Manchester bomber did it begin to acquire real striking power.[5]

Viewed in terms of the Air Corps' preparation for the heavy responsibilities it was so soon called upon to carry, the year 1935 un-

* See Vol. I, 30–31, 61–64.

† See Vol. I, 46–53.

doubtedly assumes an importance of the first rank, if only because of the B-17. But the three years which followed were full of difficulty and disappointment. The opportunity to secure a striking force of its own brought also a dual organization of Army aviation which violated the military maxim that responsibility for a single function should never be divided. The Chief of the Air Corps controlled funds, the development of equipment, and training, but tactical squadrons with few exceptions were assigned to GHQ Air Force, whose commander was responsible directly to the Chief of Staff. In theory, a necessary coordination of effort was to be provided by the General Staff, but its officers had only a limited understanding of the technical problems involved and friction between the two branches of the air arm inevitably resulted. As early as January 1936, a special board reported that sharp factionalism already had "damaged Air Corps morale."[6]

The next year brought delivery of thirteen B-17's, first of the long-range bombers to reach production, but when one of the planes "intercepted" the liner *Rex* some 600 miles at sea in the spring of 1938, a protest, presumably by the Navy, quickly followed. To the dismay of the Air Corps, verbal orders limited all overseas flights thereafter to distances within 100 miles of the coast. Airmen, in the words of General Arnold, were "burned up about it," the more so because they could never get the order in writing.[7] Still more disheartening was a subsequent stop-order on long-range bomber development. Directives of May 1938 gave air planners three sharp reminders: national policy contemplated defense only, operations over the ocean were Navy functions, and the superiority of a B-17 over "the two or three smaller planes that could be procured with the same funds" remained to be established.[8] These propositions having been confirmed by a Joint Board ruling of 29 June,[9] the War Department also put a stop to planning for new designs with the blunt assertion that "there would appear to be no need for a plane larger than the B-17."[10] For fiscal year 1940 all funds were to be put into light and medium bombers,[11] a policy hailed by *Time* magazine as a step taken "to catch up with foreign developments."[12] If the airmen had traded the hope of autonomy for the promise of strategic bombers, they had reason in 1938 to assume that they had lost the gamble. Indeed, the prospect on all counts seemed a discouraging one. Although the Baker Board had set a goal of 2,320 aircraft, the Army in 1938 had only 1,250 modern

planes on hand, plus another 1,000 on order,[13] and the production rate was a trifling 88 per month.[14]

But if 1938 brought profoundly disheartening trends of policy, it was also the year which saw them sharply reversed. This was the year of Munich when Czechoslovakia was lost to Hitler through a diplomatic defeat widely attributed to blackmail tactics backed by the threatening power of the German Air Force. The tension leading up to the Munich conference of September 1938 converted President Roosevelt into an advocate of an enlarged air program; his determination equalled the authority he possessed to place that program in the very front of the effort to build up America's military strength.

The new Presidential policy coincided with a significant change in the leadership of both the Army and of its Air Corps. Maj. Gen. George C. Marshall was ordered to Washington in July 1938 to begin the assignments which would prepare him to succeed Malin Craig as Chief of Staff a year later.[15] On 21 September 1938 a tragic accident took the life of Maj. Gen. Oscar Westover, Chief of the Air Corps.[16] His replacement was Henry H. Arnold, a personable airman who yielded to no one in his belief in air power but who also represented the moderate views which had prevailed in the Air Corps after 1934. The newly developing opportunity to build an air force was not to be sacrificed for the uncertain rewards of a renewed campaign for independence.

The Presidential Program

The tension which preceded Munich had built up over the years since the Italian invasion of Ethiopia in 1935, but it had been greatly intensified by the Austrian *Anschluss* in the spring of 1938, a move which showed that Hitler's appetite was large and that the democracies lacked the weapons with which to check his greed. The pressure against Czechoslovakia, personalized for Americans by the shrill stridency of Hitler's radio delivery, reached a new intensity with the Führer's speech at Nürnberg on 12 September. According to Robert E. Sherwood, it was after hearing this speech that Roosevelt sent Harry Hopkins to the west coast for an estimate of the possibilities for expanding aircraft production. Hopkins later recorded his conviction that "the President was sure then that we were going to get into war and he believed that air power would win it."[17] Of greater pertinence to the present discussion, perhaps, are the advices received by Roosevelt from Ambassadors Hugh Wilson, in Berlin, and Wil-

liam Bullitt, in Paris, that it was the German air potential which explained the fatal weakness of British and French policy.[18] Many other Americans held the same view, agreeing with the appraisal of George Fielding Eliot: "It is blackmail which rules Europe today, and nothing else: blackmail made possible by the existence of air power."[19]

The timing of the moves by which the President translated his new interest in air power into military programs of action is not entirely clear from the evidence now available. It has become customary to date the launching of the Presidential program from a White House conference of military and civilian advisers meeting on 14 November 1938.* But General Arnold has contended that there was an earlier conference at the White House on 28 September from which the AAF received its "Magna Carta."[20] A check of White House records fails to confirm his recollection of such a conference,† but there is strong evidence to support the view that the President had given a new impetus to War Department planning well in advance of the November conference.

By mid-October the President had begun to talk with newsmen about the mass production of aircraft, attributing his interest to trends that had "come to a head in the past month."[21] On 26 October he took the occasion of the *Herald-Tribune* Forum in New York to warn that "neither we, nor any nation, will accept disarmament while neighbor nations arm to the teeth."[22] Two days later he received the report of a special committee appointed on the 25th to survey the possibilities of a major boost in aircraft production.[23] Meanwhile, the War Department was busy with the drafting of plans for the expenditure of

* Those who met with the President at that time included Harry Hopkins; Secretary Morgenthau and Mr. Oliphant from the Treasury; Robert H. Jackson, the Solicitor General, who shortly thereafter became Attorney General; Secretary of War Woodring; Assistant Secretary Johnson and his executive assistant, Col. James Burns; Marshall; and Arnold.

† It is possible that Arnold, who cites notes taken at the meeting in question, may have mistaken the date. But there are differences in the accounts of the two conferences, if there were two conferences. For example, Jackson is not included by Arnold in his account of the meeting in September, and it is clear that he did attend in November, which was the month in which Attorney General Cummings resigned to be replaced by Jackson. In any case, War Department activity in October precludes the possibility that Roosevelt waited until the November conference to get the ball rolling. It should be noted in this connection that the President conferred with Woodring on 28 September and that on the next day he had an appointment with Chief of Staff Craig. (See Appointment Diary, Papers of the White House Office of Social Entertainments, Group 20, Roosevelt Library.)

new funds reaching as high as $500,000,000.[24] An "air" program ready by the middle of the month called for 400 million of this total; a counterproposal within a few days set forth the claims of ordnance to 349 million.[25] The issue was referred to the White House on 25 October, and this action seems to have provided the occasion when General Marshall is reported to have warned the President in the strongest terms that a program limited to air power would be "contrary to the considered judgment" of the General Staff.[26]

But that the President wanted aircraft was made abundantly clear at the White House conference on 14 November. Arnold colorfully, and correctly, expressed the President's mood during the fall of 1938 when he later recalled that Roosevelt well understood that new barracks in Wyoming "would not scare Hitler"; what was wanted was "airplanes–now–and lots of them."[27] To his advisers on 14 November the President talked in terms of 20,000 planes annually, but he indicated a willingness to think in terms of half that number.[28] In the end he actually settled for an Air Corps program of 6,000 planes, which left $200,000,000 for ground force purposes out of the original half-billion.[29] When Roosevelt presented the new program to Congress in January 1939, Arnold already had briefed the aircraft manufacturers on the need to plan for a major expansion.[30]

In a special message to Congress of 12 January 1939, the President announced that "the Baker Board report of a few years ago is completely out of date." "Increased range, increased speed, increased capacity of airplanes abroad," he declared, "have changed our requirements for defensive aviation."[31] Senator Lynn Frazier, of North Dakota, countered the President's proposal with a resolution making "war for any reason illegal," but, as *Time* commented, "never since 1917 was such a proposal more out of keeping with U.S. temper."[32] It was not that all Americans agreed with the President's purpose, which events soon made clear was to bolster the resistance to Hitler in Europe, but most citizens could agree on the need in the circumstances to strengthen our own defenses. That the Air Corps stood to benefit by this sentiment was indicated by a Gallup poll showing that nine out of ten Americans questioned favored an immediate increase in air strength.[33] On 3 April the Congress passed the program substantially as proposed.[34]

Events had overruled the Baker Board. But airmen were not long in finding out that their own aims were not in complete harmony with

those of their new ally, Mr. Roosevelt. Indeed, during the fall conferences it had been made clear enough that the President's attention was focused on plane production, that as yet he had acquired only a secondary concern for the creation of that larger—and more complex—entity which is an air force. Thinking in terms of the growing tension in Europe, he primarily sought the means to bolster immediately the capacity of European powers to resist Hitler; his plans, in other words, foretold the early development of a policy which viewed America as an arsenal for the democratic states and which inevitably clashed at times with the programs of those whose primary job was to put the United States in a state of military readiness. The Air Corps readily agreed that foreign orders were in the national interest, but once the new program opened the way for an unprecedented development of the Air Corps, clashes of interest naturally followed. The difficulty became apparent early in 1939, when newspapers revealed the presence as a passenger of a French officer in the crash of a new Douglas plane on 23 January.[35] Congressmen, quizzing General Arnold, found that the War Department had cleared the officer at the request of the Treasury, where Morgenthau was acting as the Presidential coordinator for foreign orders. It was the President, of course, who was under attack when the congressmen demanded of Arnold: "Does the Secretary of the Treasury run the Air Corps?"[36] Later, Morgenthau and Secretary Woodring of the War Department clashed openly on the plane-release issue. The President was deeply disturbed, and called a press conference to defend his policy. His displeasure seemed to center on General Arnold. In the midst of a later staff conference, the President, looking directly at Arnold, threatened exile—to Guam, perhaps—for any official who could not take care of himself at committee hearings. Until war began in Europe, nearly nine months later, Arnold regarded himself as "taboo" at the White House.[37]

From the point of view of the Air Corps, however, the advantages of the new administration policy far outweighed any of its disadvantages. Among the earliest gains was an improvement in the internal organization of the Air Corps. General Arnold, who had been recognized in the rearmament discussions as premier adviser on air matters, suggested in February 1939 that he be named "Chief of Aviation, GHQ"[38] and allowed to develop a superior air staff with control over both the Office, Chief of Air Corps (OCAC) and the GHQ Air Force. The War Department accepted the need for better coordina-

tion, but it rejected the title suggested and refused permission for a separate air staff. Instead, it was provided that as of 1 March 1939 the Chief of the Air Corps would also "supervise" the GHQ Air Force.[39] Any immediate increase in autonomy for the air arm had been rejected in a ruling foretold by Mr. Roosevelt the preceding October. When at that time reporters had asked if the new air program might lead toward a unified defense department incorporating an improved status for the air arm, the President dismissed the question as "a pure detail of later administration."[40]

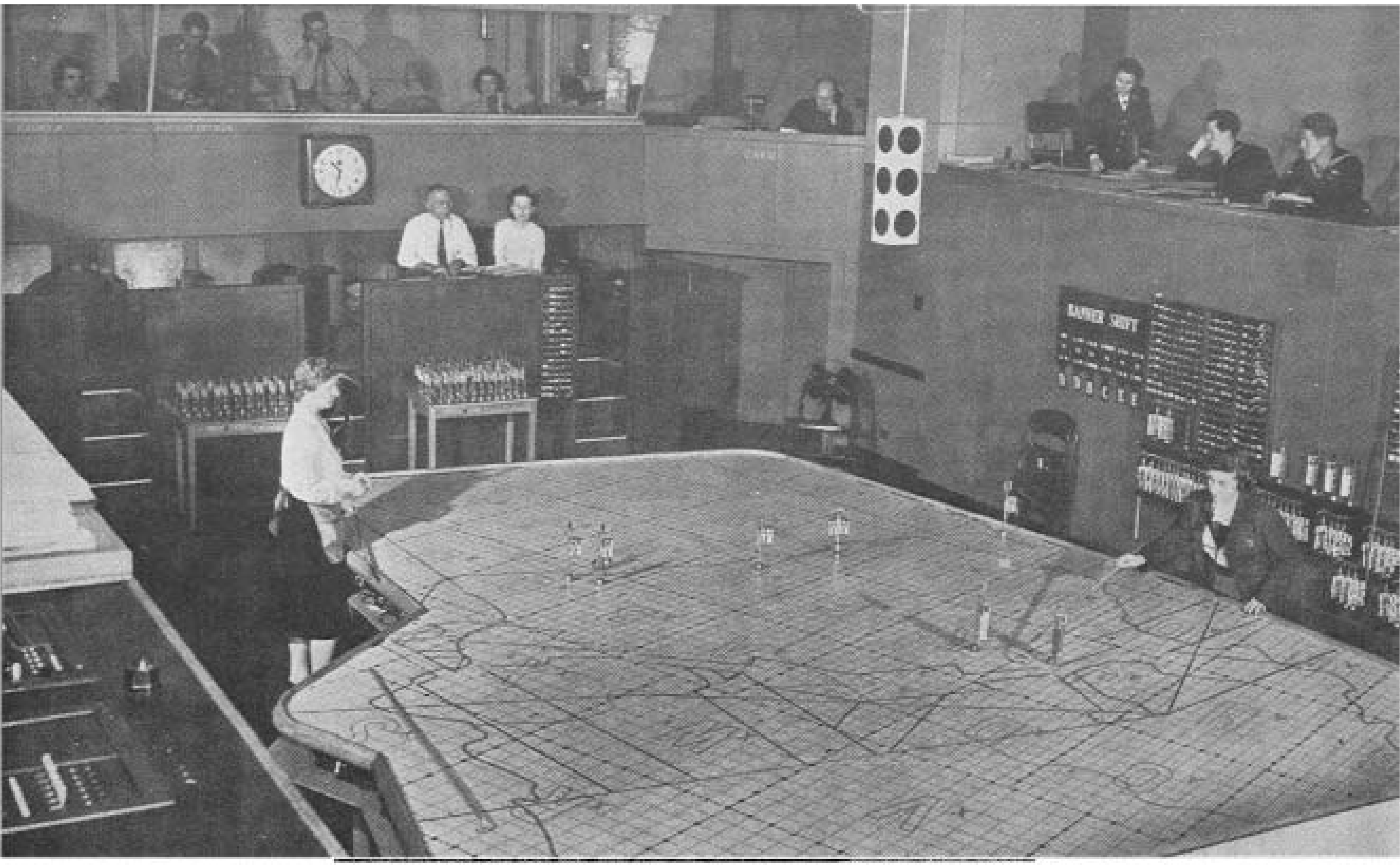
But if organizational changes stopped short of the desired goal, there was promise of an early and most helpful clarification of the Air Corps' mission. Studies undertaken by Col. J. W. Anderson of the General Staff led to suggestions for the employment of airplanes in "an active and aggressive defense involving operations beyond our territory,"[41] and on 23 March 1939 General Craig appointed an "air board" to study the problem of the use of aircraft in hemisphere defense. Its findings were reviewed for the Secretary of War on 1 September by General Marshall, who added his own conclusion that "the report establishes for the first time a specific mission for the Air Corps."[42] That mission emphasized greatly expanded responsibilities under a scheme of national defense now interpreted in the broader terms of hemisphere defense. No longer could the nation's security be guaranteed by naval forces and the conventional types of coastal defense; the approaches to the United States by way of the North Atlantic island chain and Latin America must be guarded, and for this purpose the long-range airplane had acquired special significance, both for the striking power it could provide and the flexibility it could lend to all defensive preparations. Indeed, the report called for the acquisition of outlying bases to extend even further, in Marshall's words, the "radius of action of our airplanes." The Air Corps not only had acquired a "specific" mission of its own, but that mission opened the way for the fullest development of the long-range bomber program so recently rejected.

1940: The Blitz Provokes Full-scale Rearming

Munich had aroused the President, but public opinion in the United States followed his leadership with evident reluctance until the Nazi conquest of France in May and June 1940. If thereafter resistance to the implications of Roosevelt's policies continued, there was little disagreement on the need for greatly strengthened defenses. As *Life*

HIGH COMMAND

Left to right: Gen. George C. Marshall, Lt. Gen. Frank M. Andrews, Lt. Gen. Henry H. Arnold, Maj. Gen. George P. Echols



OPERATIONS ROOM, PHILADELPHIA INFORMATION CENTER

reported, the blitzkrieg, "biggest political fact that has hit the world within the memory of living man," had stirred a "chilling fear that the national existence of the United States might soon be threatened."[43] Shortly before, on 3 April, Congress had cut an Army request for 166 planes down to 57, and had refused to provide long-range bombers on the grounds they were "aggressive" weapons.[44] But in June, Senator Lodge, a Republican, could advise General Arnold that Congress was anxious "to provide all of the money necessary for the National Defense, and so all you have to do is ask for it."[45] As Arnold later put it, "In forty-five minutes I was given $1,500,000,000 and told to get an air force."[46] President Roosevelt, who had talked of 10–20,000 planes in 1938, now spoke of stepping up output to a rate of 50,000 per year. In the twelve months beginning with July 1940 the Air Corps was to spend more than 100 million dollars on research alone, including 42 million dollars in tests of the very heavy bombers for which the General Staff in 1938 had foreseen no need whatever.[47]

The promise of greatly increased air strength emerged from new appropriations both for the Army as a whole and from special programs for the Air Corps itself. On 10 July the President went to Congress with a "total defense" budget just short of four billion dollars, roughly half of the sum being earmarked for 18,000 airplanes.[48] The unprecedented legislation of 16 September for a peacetime draft resulted from initiative outside the administration,[49] showing how far public opinion had moved. At a White House conference with Marshall and Arnold on 14 May the President had shown, in contrast to his original preoccupation with plane production, a fuller appreciation of the need for trained personnel—which is the core of an air force.[50] An as yet unrealized goal of 4,500 trained pilots in two years was then replaced by a program which anticipated the training of 7,000 pilots in a single year. Such a program depended upon tremendous expansion of existing training facilities, but the program was scarcely under way before new plans made it look modest indeed. On 8 August the President ordered a 12,000-pilot-per-year schedule, and by 17 December 1940 the goal had been set at 30,000.[51] Expressed in terms of organizational units, the 1941 effort was to focus on achievement of a 54-group program, with an 84-group air force as the ultimate goal.[52] Thus expansion of the Air Corps had become—in complexity and in lack of precedent—the leading element in a wholesale effort to prepare the nation for war.

After June 1940 the problem facing the Air Corps was no longer a

struggle for recognition and adequate funds, but rather the mounting difficulties of hugely expanded programs of procurement and training. Limited in its own resources—its strength at the beginning of 1939 had been some 2,300 officers and 19,000 men—and forced to concentrate all energies on a quick build-up, the Air Corps found in its new opportunity strong arguments against any renewal of the old fight for independence. The more critical the defense problem became, the less likely was it that the surgery required to separate the Air Corps from the Army could be tolerated. Air leaders paled at the diversion of energy which would have been involved in taking over the housekeeping and supply services provided by the War Department; with autonomy they would have to provide "out of their own pockets" even for such earth-bound necessities as cooks and bakers.[53] Willingness to work within the Army did not blind Air Corps leaders, however, to the critical need for a better organization—one that would give to the air arm a helpful degree of autonomy. The search for "a reconciling formula" went on, if anything with new vigor, but it was now an issue to be settled among friends, and the personal relations among key leaders in the defense effort naturally played a major role.

The President, no mean political strategist and never content to be merely a nominal commander in chief, held the ultimate key to reorganization. His experiences in World War I as Assistant Secretary of the Navy had predisposed him to distrust the airmen. In 1919, Mr. Roosevelt had written disparagingly in the *New York Times* about the vanity of the airman, who thirsted "to be known as the man who tore wide open existing governmental organizations," and he had predicted that "not until we do away with armies and navies altogether, or until the development of aircraft relegates land forces and the Navy to the scrap heap will the time arrive for a United Air Service."[54] Trends after 1920 weakened any threat air autonomy ever held for the right of the Navy to control its own air arm, however, and by the time Mr. Roosevelt became President, he was counted—even by Billy Mitchell—as a friend of aviation. Until 1938 no substantial token of this interest was manifest and even then Mr. Roosevelt was more interested in plane production than in the development of a full-fledged American air force, but he soon displayed an alert awareness of the long-term requirements of such a force. No mention of the part played by the President would be accurate without acknowledging that the shortest distance from the War Department to the White House was by way of Harry Hopkins. Fortunately for the airmen

they had in Hopkins a friend at court, one placed by General Arnold among "the most enthusiastic supporters of American Air Power."[55]

In the critical month of June 1940 the President named a new Secretary of War, Henry L. Stimson.[56] By his acceptance of the post, Stimson, who described himself as "a Republican doing nonpartisan work," helped lift the defense effort above politics.[57] His immense prestige came from distinguished service as Secretary of War for President Taft and as Secretary of State under Hoover. Under Taft he had helped establish the supremacy of the Chief of Staff and had learned that "the vast inertia of somnolent inbreeding" in the Army could be overcome only by forceful measures.[58] Although he was never at ease in what he termed "the inherently disorderly" Roosevelt administration,[59] he enjoyed the warmest personal relations with the President and was given a free hand in the War Department. The new Secretary was willing to delegate authority, but periodically "dipped down" to make certain that critical problems were swiftly solved. Of decisive importance for airmen was his advocacy of new weapons and of close relations with scientists. An outstanding example is provided by Stimson's initiative in speeding radar development.[60]

Convinced by 1940 that "air power has decided the fate of nations,"[61] Stimson quickly saw the need for an assistant who could be, in effect, an acting "Secretary of the Air Force." The Air Corps Act of 1926 had provided for an assistant for air, but the post had never been filled. Stimson brought Robert A. Lovett into his office in November 1940[62] and the following April named him Assistant Secretary of War for Air, turning over to him the heaviest burdens of Air Corps procurement, organization, and public relations. Lovett's original interest in flying went back to his membership in the Navy "Yale Unit" in World War I, in the course of which he had won the Navy Cross. After the war he became a successful banker, but kept up his interest in aviation. When he took over in 1941, he found air matters in what he called "a hell of a mess,"[63] but his energy and tact were major contributions to the rapid progress which followed. Although he shared the general views of Mitchell about air power, *Time* noted a complete contrast in the way the two men worked: "Lovett gets things done by pushing the right button instead of wrecking the keyboard."[64] This estimate misjudges the problem Mitchell faced, but it does properly emphasize the finesse which helped Lovett win with a minimum of friction substantial autonomy for air.

It was fortunate that the man who began on 1 September 1939 a

six-year tenure in the office of Chief of Staff was George C. Marshall, an officer of remarkable selflessness and exceptional organizing ability. As a product of the General Staff system, he might have been expected to take a dim view of air force ambitions, and during the lean years between wars he had not escaped the Army's feeling that each gain for the Air Corps had been bought at the price of further "emasculation of the basic ground forces."[65] But after 1940 the whole picture had changed: no longer were inter-service relations governed by a basic competition for survival. Marshall quickly demonstrated what General Arnold has called the "ability to digest what he saw and make it part of as strong a body of military genius as I have ever known."[66] His open-mindedness toward airmen already had been demonstrated when Marshall brought in Maj. Gen. Frank M. Andrews, the first commander of the GHQ Air Force, as the first Air Corps officer to serve as Chief of Operations (G-3) of the General Staff.[67] Marshall was not one to rush into "change for change's sake," but once convinced of the need for reform, he never let orthodoxy or vested interests stand in the way.

The Secretary of War and the Chief of Staff could remove traditional barriers to air autonomy, but in the final analysis the problem had to be solved by Lovett on the basis of professional advice drawn from Arnold's "tiny" staff. That "Hap" Arnold led the new air effort was in large part the result of historical accident, but there was peculiar justice in the fact, for he epitomized the Air Corps at its enthusiastic best. Arnold had learned to fly in 1911 at the Wright brothers' school, and somehow he had survived the physical perils of early planes and the political hazards of the Mitchell period. He was commanding the 1st Wing, GHQ Air Force, when summoned "over the fence," into the OCAC. Reporting to Washington in January 1936 as Assistant Chief, he was advanced at Westover's death in September 1938 to the post of Chief of the Air Corps.[68] In this new assignment, it soon became evident that he would need all his familiarity with every branch of the air service, plus new political skills of a high order.

Strong public pressures influenced the War Department action in providing greater recognition for air power. When the President spoke in May 1940 of the need for 50,000 planes per year, Al Williams, journalistic spokesman for aviation, retorted that it was "the sheerest folly to paint a vision of adequate defense until we

have, as the first essential, a separate and independent air force."[69] The writings of Williams, Alexander de Seversky, and others kept aviation matters in the public's mind, but were not always temperate or helpful to those in power. In the presidential campaign of 1940 Wendell Willkie brought some of these issues into politics by advocating a Department of Defense to include a separate air force.[70] Because of its direct effect in the War Department, however, the suggestion of greatest interest was one made by G. de Friest Larner, who represented the point of view of the National Aeronautics Association. Larner told Assistant Secretary of War Patterson that despite his admiration for General Marshall he was convinced that General Staff attitudes still impeded progress. To quiet criticism, Larner suggested that Arnold be made Deputy Chief of Staff for Air. Patterson endorsed the idea to Stimson on 18 September 1940 with the observation that the "considerable" agitation for action "may well cause us to look over our present organization and see whether our air force could be handled more effectively."[71] Stimson agreed that a review was in order, but Marshall received the idea with marked reservations because of the suggestion of outside pressure.

Even so, General Marshall's mind was open to proposals for change. Since the General Staff organization, depending on time-consuming concurrences, was proving unsuited to the vigorous action needed for raising a mass army, General Marshall on 26 July 1940 activated GHQ, with Maj. Gen. Lesley J. McNair in command, and transferred to it the immediate task of training tactical units through the four field armies which had been set up in 1932. This action at once raised a question of the relation of the GHQ Air Force to the new headquarters, whose function as a training command was different from that originally envisioned for it.[72] This question was coupled with that of a Deputy Chief of Staff for Air in a request from Marshall that Air Corps planners submit a study of the problem of organization.[73]

Fundamental reforms of the entire War Department structure were proposed by General Arnold on 5 October 1940 in a paper which presented the Air Corps philosophy of the proper place of aviation in defense organization.[74] Noting the "ever increasing cries" for air autonomy, Arnold proposed for the Army three deputy chiefs, one each for ground, air, and service forces, each deputy to

have his own staff and issue orders in the name of the Secretary of War. The Chief of Staff would reconcile differences and retain final power of decision. The Deputy Chief for Air would control all troops of OCAC and GHQ Air Force except those committed to war theaters. This plan, which so closely foreshadowed the reforms achieved in 1942, gave the three essentials of the airmen's program: a separate air staff, a unified air arm, and an air force coequal with ground and service forces.

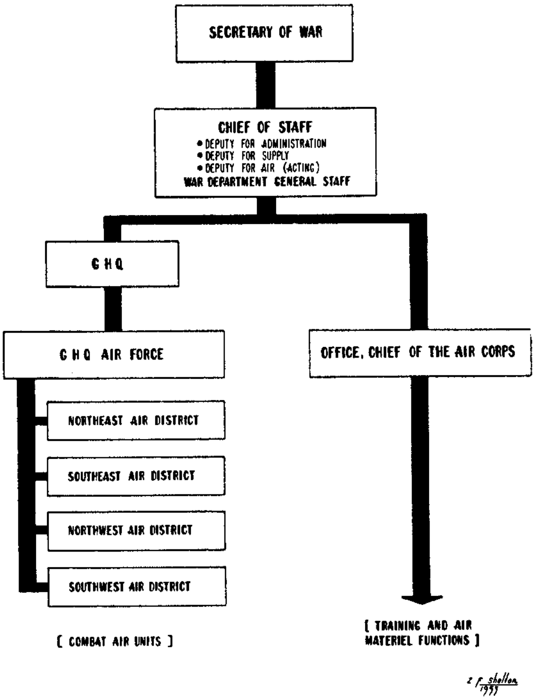
The plan immediately met emphatic opposition from key officers of the General Staff. German tactical success with ground-air support had confirmed their old faith that aviation was an auxiliary arm, and they now told General Marshall: "The Air Corps believes that its primary purpose is to defeat the enemy air force and execute independent missions against ground targets. Actually its primary purpose is to assist the ground forces in reaching their objective."[75] In line with this philosophy, G-1 recommended that the GHQ Air Force be removed from the control of the Chief of the Air Corps and placed, instead, under GHQ.[76]

General Marshall met the sharp conflict with a compromise which disappointed the airmen. Arnold was made Acting Deputy Chief of Staff for Air, as of 30 October 1940, but the real fight was lost when an order effective 19 November assigned the GHQ Air Force to the ground-dominated GHQ.[77] All elements of the air program were left unsatisfied: there was to be no high-level air staff, no unity of the air arm, and no equality with ground forces. Maj. Gen. George H. Brett, who became Acting Chief of the Air Corps when Arnold was made Deputy Chief for Air, was sharply critical in a memo of 26 December 1940. The new system was cumbersome in peace and would be disastrous in war, Brett insisted. The idea of having General Staff review of the plans drawn "by the best qualified air staff available" would produce "interminable delay, [and] the emasculation of basic plans and policies."[78]

An important internal change of the period improved the ability of the air arm to direct the major expansion involved in the 54-group program. Originally the GHQ Air Force was so small a command that its headquarters could direct work through three wings, but the need for close control of the details of the expansion program made new territorial subcommands essential. The plans of late 1940 therefore provided four air districts to serve as both tactical and ad-

ministrative units. These were tactical because they operated bomber and air defense commands in the continental area and because they were to provide fully trained units for task forces. Administratively the districts were to supervise all aspects of the work of aviation units except for service functions reserved to the corps areas.[79] Ac-

THE ARMY AIR ARM
(LATE 1940)



tivated on 16 January 1941, the new Air Districts (Northeast, Southeast, Northwest, and Southwest) moved rapidly to expand existing air bases, to select new ones, and to form and train the squadrons of the new air force.[80] Individual training and air materiel continued to be the concern of OCAC.

The Army Air Forces

Though the reorganization of 1940 disappointed the hopes of U.S. airmen, the march of world events was in their favor. For a year after the fall of France only Britain stood in active opposition

to Nazi pretensions. All resistance on the continent had been crushed, and it was clear that for many months to come the only offensive that could be mounted against Germany would have to be an air offensive—a fact which strengthened the case for an increased emphasis on aviation in U.S. defensive preparations.

With the coming of 1941 these preparations were increasingly geared to the assumption that the United States might have to fight as an ally of Britain. To the public the most significant indication of the trend of American policy was the Lend-Lease Act of 11 March 1941, but within the War Department secret American-British staff conversations beginning on 29 January in Washington exercised the greater influence on military planning. These conversations avoided any hint of an alliance, but the agreements embodied in ABC-1 of 27 March outlined measures of collaboration to be taken if events compelled the United States to enter the war. In ABC-1 the territorial integrity of the Western Hemisphere was recognized as the paramount concern of the United States, but the report outlined seven possible lines of combined action against Germany. Of these, only two could be viewed as early possibilities: a blockade of the Axis powers and "a sustained air offensive to destroy Axis military power." A separate annex, ABC-2, gave detailed measures for air collaboration.[81]

The primary role accorded aircraft was recognized in an official War Department review of the ABC agreements: "United States operations initially are limited to providing combat aviation in support of the British Isles."[82] Not only did this refute the General Staff argument of October 1940 denying that the air arm might have a mission independent of the ground forces, but air officers soon found themselves assuming roles of expanding importance in the implementation of new plans for the assistance of Britain. The ABC planners had agreed that planes would have to be released in greater numbers for Britain, even at the expense of the 54-group program, and that planning should begin for an American bomber command capable of operating from British bases if events made this necessary. To correlate plans in these matters, General Arnold was sent to England in April 1941. Intimate talks with Churchill and top British staff officials brought home to Arnold the fact that as the leader of the air force he had entered "the big leagues."[83] A second evidence of the same trend was the appointment as head of the Army

mission to Britain of Maj. Gen. James E. Chaney, an air officer.[84] Whatever the organizational charts might show, the Air Corps was acquiring a position of new and expanding responsibility. As General Arnold remarked, the stepchild of 1918 had become in 1941 the only military branch with a mission: "No Allied soldiers could even get near a battleground in Western Europe except the airmen."[85]

Even in the lower echelons developments abroad served to encourage the assignment of heavier responsibilities to air commands. Experiments with the concept of regional defense commands in the Caribbean and Alaskan areas led in March 1941 to the constitution of four such commands within the United States: the Northeastern (later Eastern), Central, Southern, and Western Defense Commands.[86] These commands were for the time being hardly more than appendages to the staffs of the four field armies, whose geographical location corresponded with the designation given the new commands, but since in time of war the armies might be moved in accordance with tactical requirements, the defense commands carried the responsibility for planning a permanent and integrated air-ground defense for the region. To make air force designations correspond with those of the four field armies with which they must cooperate in defense planning, an order of March 1941 converted the air districts of the GHQ Air Force into four separate Air Forces,[87] numbered First through Fourth. A warm fight over the right of these air forces to control air defensive preparation had by then been settled in favor of the airman's view.

The battle-proved methods of the RAF, fully reported as the Battle of Britain progressed, carried great weight, though at first only with airmen. In December 1940, Air Corps leaders were disturbed at rumors that air defense would be assigned to ground commanders, and they made strong recommendations to General Marshall in favor of "the highly successful" British pattern of integrated air defense (fighter) commands under air force leaders.[88] By 10 February, the War Plans Division (WPD) completed a General Staff study which urged, instead, that air defense be an integral part of the defense command mission. Arguing that the British fortress-type air defense would not be needed in America, WPD could not visualize air defense units as active aviation commands, but rather as control agencies to coordinate the total civilian-military defenses.[89] A major conference, on 18 February, recommended air defense

units under a single commander—but did not specify which commander.[90] On 20 February General Arnold urgently pressed on Marshall the Air Corps' conviction that any move to split command agencies from the highly complex team of fighter planes and aircraft warning units would have disastrous effects on combat-readiness.[91] At the same time, air planners also feared that if all combat units were assigned to theater-type (ground) defense commands "the GHQ Air Force will then be divided in four parts, under four separate commanders."[92] The leaders feared a return to conditions which had existed before 1935, when striking force had been lost by a parceling out of air units.

The airmen won the contest for control of air defense and for the integrity of the air striking force. Perhaps the decisive factor was the deep impression made on Marshall by his study of reports from observers in England. On 18 February 1941 he ordered speedy acquisition of superior RAF air interception and air communication equipment, in order that "full advantage be taken of British war experience."[93] This may well have conditioned the action Marshall took on 28 February on the issues of organization: "I have come to the decision that the Air Defense set-up should be in time of peace under the direction and control of the Commanding General of the GHQ Air Force."[94] The orders which in March 1941 established the defense commands also made the GHQ Air Force responsible for preparing "the aviation and air defense portions of defense plans" and for organizing and training the active air defense machinery.[95] Creation of an aircraft warning service was reassigned from the four Army commanders to the GHQ Air Force, which delegated immediate control to interceptor commands—the air defense commands of earlier plans—to be set up in each of the four new continental air forces. In addition, each air force was to set up a bomber command organized as a mobile aviation task force for offensive operations. Thus the 1941 mission of the four air forces involved heavy new responsibilities: in addition to training units for the 54-group program, each air force had to create a strategic bomber force and had to direct a vast net of ground observers, radar stations, filter and information centers, antiaircraft artillery, and fighter plane squadrons which—it was hoped—could provide by August 1941 a full-scale continental air defense.

March 1941 was also a decisive month in settling the general issue

of the proper relation of the air force to Army structure. As late as February, the War Department, speaking through Mr. Patterson, opposed bills for a separate air force and contended that nothing in the European war had altered its conviction that the existing organization was best suited to the integration of ground-air efforts. The confusion involved in any experiment, it was submitted, "might well result in a national tragedy."[96] An utterly different point of view was presented by Robert Lovett, who on 10 March sent Stimson a vigorous statement of his view that the airplane was a revolutionary weapon which demanded "a tight-knit, flexible organization as modern as the instrument itself."[97]

What finally persuaded General Marshall to make changes was not, however, the lesson of foreign experience, but rather the administrative clumsiness of existing channels. One day late in March while waiting to testify before a Senate committee, Marshall learned from General Brett how difficult it was to get prompt action from the General Staff on air matters.[98] Extensive conferences on 26–27 March convinced Marshall and Stimson that a genuine reformation was essential. Stimson therefore ordered that steps be taken "to develop an organization staffed and equipped to provide the ground forces with essential aircraft units for joint operations, while at the same time expanding and decentralizing our staff work to permit Air Force autonomy in the degree needed."[99] Air autonomy "in the degree needed" was to be accompanied by a single command for the air arm, and the first action Marshall took to implement the directive ordered (28 March) that thereafter the Deputy for Air, General Arnold, would coordinate all air matters. Recognizing that the Air Corps had "a tremendous procurement program tied in with new developments, and now has a tremendous personnel problem," Marshall admitted that "we have to operate on a simpler system." Nevertheless, the Chief of Staff wanted to progress carefully: "I desire to proceed on a basis of evolution and general understanding between all."[100]

The first public move toward the new air force structure was the appointment, in April, of Robert Lovett as Assistant Secretary of War for Air.[101] Lovett was already at work with Marshall and Air Corps leaders to explore the possibilities of change. In a conversation of 3 April Marshall and Lovett agreed that quasi-autonomy for air would be preferable to a sudden separation from the Army.

Marshall recognized that air officers had been "battered around in a maelstrom," and that his own position was involved: "If I have to spend my time battling others, I am lost." Marshall saw in Lovett someone who "will permit these fellows to work."[102] Lovett began by working with the Plans Division of the Air Corps on details of new organization charts. These moves were not known to the public, and meantime the crusade for radical change reached a new intensity on 29 April when Congressman James Scrugham of Nevada contended that the opposition to a separate air force came from "the dead hands of entrenched bureaucracy" and that the "hydra-headed air authority" caused both waste and weakness.[103]

Despite recognition by top leaders of the need for reform, there was still vigorous disagreement within the War Department on what autonomy should mean. By 13 May the Air Corps had drafted a plan to unite all Army air units under a Chief of Aviation, but proposals for an air staff touched off a sharp debate.[104] Marshall's G-3 said that no new General Staff section was needed to handle air matters and that existing offices, working with "a small personal or secretarial staff" for the new air chief would be entirely adequate.[105] A major conference at the War College on 13 June worked out a compromise, but neither airmen nor traditionalists were satisfied. General Brett felt that plans fell far short of the "reasonable autonomy" which had been promised and that there would be legal problems involved in creating new agencies to take over functions assigned to the Air Corps.[106]

The Army Air Forces emerged on 20 June 1941 from these compromises. Congress did not have to take action; rather, the changes were effected by a revision of Army Regulation 95-5, defining the War Department view of the status, function, and organization of its air arm.[107] The new Chief of the Army Air Forces, who was also to serve as Deputy Chief of Staff for Air, was to coordinate the OCAC agencies and an Air Force Combat Command (AFCC) —the latter being a redesignation of the GHQ Air Force. An Air Council was provided as a policy board for periodic review of major aviation projects; it included the Assistant Secretary for Air, the Chief of AAF, the Chief of WPD, the commander of AFCC, and the Chief of the Air Corps. Merely to list these officials shows how badly divided the air organization still remained, but the provision of an air staff for the new Chief of the AAF represented a distinct

step forward. Aviation units still reported through two chains of command, with the AAF on the same echelon as GHQ. The Chief of the Air Corps continued to direct training and materiel procurement, but the structure of his office became more complex as new functions, such as ferrying, led to the creation of new commands or bureaus. The AFCC was the striking force, or tactical branch, controlling the four continental air forces and their subordinate bomber and interceptor commands. The air defense mission formerly assigned to GHQ Air Force was now given to the Chief, AAF,[108] but was delegated to AFCC and its interceptor commands.

These changes of June left the air force as a subordinate division of the Army, but two actions in the summer of 1941 showed that forces outside the War Department were pushing the air commander to the very highest military level. With approval by the President on 10 July the Joint Army-Navy Board added to its membership the Deputy Chief of Staff for Air of the Army and the Chief of the Navy Bureau of Aeronautics, though their participation in the work of the board was limited to air matters.[109] When the Atlantic conference of August 1941 was being planned, Harry Hopkins insisted that an American airman must be included to deal with issues the RAF might raise.[110] By a little-noted transition General Arnold was taking his place as a junior member of the top military command.

The creation of the AAF in June 1941 had given the airmen only part of their three-point program: there was now an air staff, and a single commander of the air arm, but to achieve equal status with the ground forces a fundamental reconstitution of the War Department was required. General Marshall was not yet convinced that so drastic a step was wise. In September 1941, in a letter drafted for Stimson to send to a Senate committee, Marshall firmly opposed a separate air force because of the danger to unity of command. German success, Marshall thought, had come by "the subordination of air power to the supreme command of the armed forces." He believed that the changes of June gave air autonomy in a frame of careful Army control: "Coordination and unity of command is obtained through the Chief of Staff, and organization of 'Task Forces' for training and combat operations, under GHQ."[111]

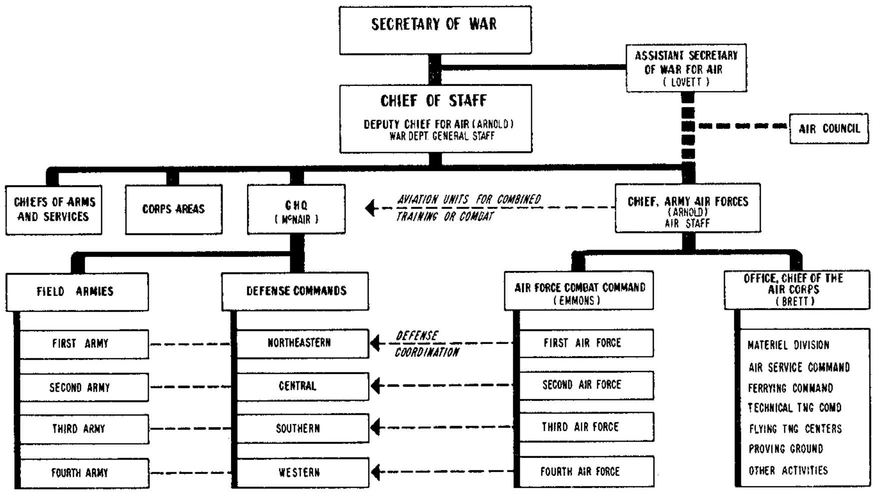
The way for basic reform was finally opened by the need for resolving a critically confused division of authority in the highest Army command. Although on its activation in July 1940 GHQ had

been limited to supervision of training, the expectation was that it would eventually control troop deployment and combat operations, and by an order of 3 July 1941 Marshall made GHQ responsible for the command in potential theaters of operations—Iceland being one of the first assignments.[112] The original concept of GHQ, as influenced by Pershing, had anticipated a single-theater war, but by 1941 the prospect that combat operations might not be limited to a single theater had become all too clear. Already the existence of GHQ served to complicate the exercise of the over-all authority of the War Department. Marshall administered some defense areas through WPD, and others through GHQ. The latter agency was caught in a cross fire: its chief concern was training, but it shared planning functions with WPD, supply matters with G-4 of the General Staff, and operational planning with the newly created air staff. By mid-August sharp conflicts led Marshall to convene a committee to study the issues in the larger context of ultimate Army functions.[113] A complex "battle by memos" ensued, in which key officers of WPD sided privately with the air force view that GHQ should be eliminated. For the record, though, WPD deferred to Marshall's desire to continue with a command post outside the War Department, and on 30 August recommended that GHQ be left substantially unchanged. Of more significance was a study made by Lt. Col. William K. Harrison of WPD, which apparently did not go to Marshall but which air force planners reviewed.[114] Harrison proposed separate Zone of Interior commands for air, ground, and service forces, plus a command section inside the War Department. Here was the essence of the solution finally achieved, and it fitted in perfectly with the airmen's desire for equality with ground forces. On 24 October Brig. Gen. Carl Spaatz, for the AAF, formally submitted a reorganization plan which incorporated these ideas, including abolition of GHQ, but the plan was unanimously opposed.[115]

By November 1941 the lack of clear channels of command had produced disturbing failures to follow through on orders given to defense areas. On 3 November, Marshall admitted that he had "the poorest command post in the Army and we must do something about it, although I do not yet know what we will do. . . ."[116] The AAF had very definite ideas about what should be done, and on 14 November General Arnold provided Marshall with a detailed pro-

posal which became the basis of final agreement: this converted GHQ into a ground force training command, grouped supply services under a service command, and called for a unified air command. The Chief of Staff, through a superior staff, would direct the entire Army effort.[117] On 18 November, WPD concurred with the broad outline of the plan. General McNair had already indicated (21 October) that GHQ should be abolished if the existing conflicts could not be otherwise resolved. For the first time Marshall

AVIATION IN ARMY ORGANIZATION
(LATE 1941)



was ready to consider a command device other than GHQ, and on 25 November he expressed himself as "favorably impressed by the basic organization" of the Arnold plan. With the approval of Stimson, Marshall ordered WPD to develop detailed charts.[118] Two weeks later came the Pearl Harbor attack, but this, while delaying action on proposed changes, served also to reinforce the conviction that a basic change was imperative.

The Munich crisis had awakened the Roosevelt administration to the growing significance of air power in world politics. The swift debacle in France had confirmed the need for a rapid build-up of America's strength in the air. The attack on Pearl Harbor cleared the way for quick reform to give the Army's air forces equality with its ground forces.

CHAPTER 2

* * * * * * * * * * *

THE AAF

THE Army Air Forces, successor to the Army Air Corps and forerunner of the United States Air Force, owed its designation to Army Regulation 95-5 of 20 June 1941. But it was a War Department circular of 2 March 1942, and in a more fundamental sense the war itself, which gave the new organization its peculiar qualities as a subordinate and yet autonomous arm of the United States Army—an arm which by the close of the war had emerged as virtually a third independent service. The history of this development is one of unusual complexity, and for students of institutional developments one full of interest.

Officially, the AAF never became anything other than a subordinate agency of the War Department charged to organize, train, and equip air units for assignment to combat theaters. Its jurisdiction was wholly limited to the Zone of Interior, and it could communicate with air organizations in combat theaters only through channels extending up to the Chief of Staff, and then down through the theater commander to his subordinate air commander. The position of the AAF, in other words, was no different from that of the Army Ground Forces and the Army Service Forces, the other two of the three coordinate branches into which the Army had been divided. So, at any rate, read the regulations.

Actually, the Commanding General, Army Air Forces, as one of the three service representatives on the Joint Chiefs of Staff, functioned on a level parallel to that of the Chief of Staff. As a member of the Combined Chiefs of Staff, he moved at the very highest levels of command in the wartime coalition with Britain. He chose the commanders of the combat air forces, who well understood that he possessed as much power to break them as he had to make them.

With the air commanders overseas he communicated regularly, as often as not without reference to formal channels. Controlling the means necessary to implement operational plans in any theater, he exerted a powerful influence on the development of strategy, tactics, and doctrine wherever AAF units fought. He operated a worldwide system of air transport whose planes moved at his command through all theaters, the commanders of which were denied their traditional prerogative of controlling everything within their area of responsibility. Toward the close of the war, he even exercised direct command of a combat air force—the Twentieth. Throughout the war his staff functioned in a threefold capacity: it superintended the logistical and training establishment of the home front, advised its chief as a member of the high command, and helped him run the air war in whatever part of the world there seemed to be need for attention by Headquarters.

In drawing any such contrast as that above, one always runs the risk of overstatement. The contrast between theory and fact is so fundamental to an understanding of the AAF, however, that some exaggeration may be justified at this point for the sake of emphasis. Necessary qualifications will be noted in the following text, which attempts not so much to provide a detailed discussion of AAF organization as to suggest the broad outlines of its structure and the factors governing its relations with other military organizations.

Headquarters, AAF

Soon after Pearl Harbor it became clear that the Army's over-all organization was not suited to the requirements of war. Events, in short, had documented the AAF contention that only a fundamental reconstitution could solve the Army's problems. The coming of the war brought with it also, in the First War Powers Act of 18 December 1941,[1] broad executive authority to effect necessary changes without further action by Congress.

The key figure in drafting the final plans was Maj. Gen. Joseph T. McNarney, an Air Corps officer with considerable experience on the General Staff. Returning in December 1941 from a mission to England, McNarney first served on the Roberts Commission in its investigation of the Pearl Harbor disaster. But next, on or about 25 January 1942, he teamed up with Col. William K. Harrison, Jr., of WPD and Lt. Col. Laurence S. Kuter of the Air Corps to complete

an intensive survey already begun by them of War Department organization.[2] Simultaneously, a team of air officers developed detailed plans for the necessary reorganization of the AAF, where there existed some sentiment in favor of an Air War Plans Division (AWPD) plan for equal air, ground, and naval forces operating under a small Presidential staff,[3] somewhat along the lines fixed by British usage. The McNarney group, working swiftly, completed on 31 January a basic scheme which ignored this drastic proposal and depended instead upon the plan proposed by General Arnold in November 1941.* By 11 February Marshall ordered final drafts made. McNarney set up an executive committee with a blunt warning that it was not to be a "debating society," and rapidly shaped the necessary directives. Stimson and Roosevelt having approved the plans, on 28 February Executive Order 9082 directed that the new organization take effect on 9 March.[4] Meantime, popular demand for action had been so vocal that *Time*, for example, predicted on 9 February that unless more autonomy for the air force was quickly provided "the hue and cry for a separate air arm . . . will go up again, louder and clearer than ever before."[5]

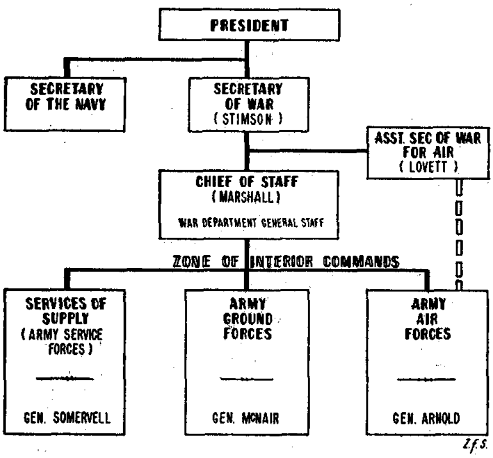
What Stimson called the formal recognition of quasi autonomy for air[6] was achieved with the publication of War Department Circular 59 on 2 March 1942 (effective 9 March) outlining a new "streamlined" Army.[7] The AAF now became one of the three autonomous commands into which the Army was divided. The Services of Supply (later, Army Service Forces) incorporated under one headquarters the varied logistical services of the Army and was responsible for providing all supplies and equipment, except such as were peculiar to the air forces. The Army Ground Forces (AGF) took over the training function of GHQ, which now was inactivated. Like AGF, the AAF was charged with a training mission, but it also carried an independent responsibility for supply and equipment peculiar to air operations. The three new commands were intended to relieve the General Staff of much of the administrative detail which formerly had burdened it, and thus to free it for service as an advisory body on general policy. With GHQ out of the way, the War Plans Division, forerunner of the powerful Operations Division (OPD), became the "command post"† through which the Chief of

* See above, pp. 26–27.

† The description is borrowed from Ray S. Cline's aptly titled *Washington Command Post: The Operations Division* (Washington, 1951).

Staff ran the Army, at home and overseas. In lieu of the three deputies who had been assisting the Chief of Staff, there was now to be only one deputy chief, a post going immediately to McNarney and to be held by him until October 1944. The reason for this choice was made clear a few months later when Eisenhower, urging McNarney's name for the theater command in Europe, learned that "to insure integration and to build up mutual confidence, General Marshall felt it essential that . . . his deputy should be from the Air Corps."[8] Thus did Marshall seek to preserve unity of command while giving the AAF autonomy on the operating level and representation

THE AAF IN THE WARTIME ARMY



at the top policy-making level. In only one way could it be argued that the AAF had lost ground: its commanding general was no longer a deputy chief of staff. But in the circumstances that mattered little.

The Air Corps, after March 1942, continued to be the permanent statutory organization of the air arm, and thus the principal component of the Army Air Forces. But the Office, Chief of Air Corps and the Air Force Combat Command were both abolished, their functions being assumed by AAF Headquarters. The dissolution of AFCC had been foretold soon after the outbreak of hostilities by developments which robbed it of any true function. Defense commands on the east and west coasts had been activated as theaters of operations, and the First and Fourth Air Forces had been assigned, respectively,

to their control.* Simultaneously, the Second and Third Air Forces found themselves committed primarily to a mission of training that was the concern of OCAC rather than of AFCC. The disbandment of the latter command eliminated at last the dual structure which had been a source of continuing confusion in the organization of the air arm since 1935.

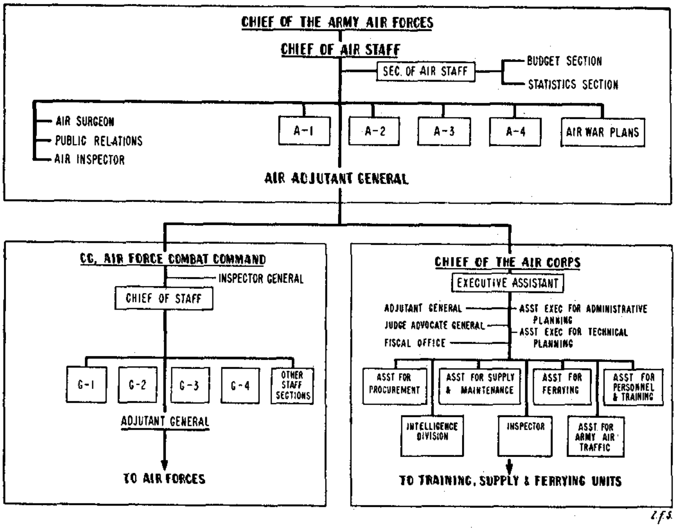
According to WD Circular 59, the official mission of the AAF was "to procure and maintain equipment peculiar to the Army Air Forces, and to provide air force units" for combat assignment.[9] In the inimitable manner of military directives, this prosaic phrasing masks the true dimensions of the task, which may be suggested by a few statistics, most of them bearing evidence of the ultimate accomplishment. A mere handful of professionals—there had been only 1,600 Air Corps officers in 1938—were spread thin to direct the recruitment, training, and equipment of a force which at its peak strength in March 1944 totaled 2,411,000 persons and made up 31 per cent of U.S. Army forces.[10] In addition, the AAF employed up to 422,000 civilians, a maximum reached in October 1944. Expressed in terms of combat units, AAF goals rose from the 115-group program approved in January 1942, to the 224-group objective set up in July, and then to the maximum 273-group program adopted in the following September.† On paper 269 groups had been formed by the close of 1943, but rescheduling reduced the actual peak to a total of 243 in April 1945, of which 224 groups were then deployed overseas. The composition of the 243-group force shows the direction of the AAF effort: there were 26 very heavy bombardment groups, 72.5 heavy bombardment groups, 28.5 medium and light bombardment groups, 71 fighter groups, 32 troop carrier groups, and 13 reconnaissance groups. AAF personnel assigned overseas reached the figure of 1,224,000 in April 1945, with 610,000 deployed against Germany, 440,000 against Japan, and the remainder assigned to air transport duties or at scattered outposts. Altogether, up to V-J Day the AAF took delivery on 158,880 airplanes, including 51,221 bombers and 47,050 fighters. Maximum aircraft strength at any one period was reached in July 1944, at which time there were 79,908 aircraft (excluding gliders). The combat air forces, thus equipped, dropped 2,057,000 tons of bombs on enemy targets—three-

* See below, p. 72.

† See Vol. I, 251, and below, pp. 279–87.

fourths of it against Germany—and fired 459,750,000 rounds of ammunition. Altogether, 2,363,800 combat sorties were flown, 1,693,000 of them against Germany. Personnel casualties of 121,867 included 40,061 dead (17,021 of these were officers). Aircraft losses on combat missions came to 22,948 planes. The cost of the effort, in direct money expenditures by the AAF from mid-1940 to V-J Day, was $38,345,000,000[11]—over one-tenth of the total direct costs of the war to the United States.

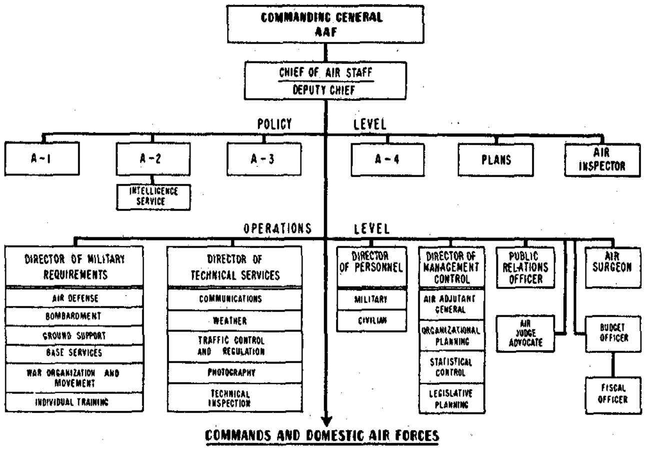
AIR FORCE STAFF LEVELS, DECEMBER 1941
(SIMPLIFIED)



Although many different organizations, and by no means all of them AAF units, contributed to this gigantic effort, the fullest responsibility fell upon Arnold and the reorganized Air Staff at AAF Headquarters. That staff, though it could claim descent from the Air Service of World War I through the Office, Chief of Air Corps, for all practical purposes had its origin in June 1941, when the Plans Division of OCAC provided the nucleus of A-staff sections to advise the newly created Office of the Chief, AAF.[12] The Air Staff thus established was supposed to function at a policy-making level, with decisions to be implemented through OCAC and AFCC. Acute dissatisfaction with the division of authority inherent in this tripartite organization had led the McNarney committee to decree a consolidation of the functions in one staff. But the committee clung to the

belief that there would be an advantage in maintaining a distinction between policy-making and operating sections of the single staff. Perhaps this distinction was maintained because the reform simultaneously planned for the General Staff depended to some extent upon the same division. Or perhaps the influence of the RAF should be chiefly credited, for its system of directorates had greatly impressed American observers, and fully two months before the March 1942 reorganization the AAF had set up test directorates for study of the RAF organization.[13] Whatever the reason, the AAF was

AAF ORGANIZATION, 9 MARCH 1942



directed to establish separate policy and operating staffs for control of the subordinate commands through which the Army's aviation objectives would be accomplished.

Under the new organization, policy would be determined by A-1 (Personnel), A-2 (Intelligence), A-3 (Training and Operations), A-4 (Supply), and Plans, which toward the end of the war was sometimes designated A-5. The Air Inspector was also put on this level. The policy staff was to schedule the programs of the AAF, with synchronization entrusted to Plans, which thus became and remained the key office in AAF Headquarters. Through the work of this part of the staff detailed requirements would be established for guidance of the operating staff, which was built around four directorates: Personnel, Military Requirements, Technical Services, and Management Control. As these titles suggest, each of the first

three offices was intended to provide centralized direction of a variety of activities which bore on the successful performance of a major function of the AAF, while the fourth centralized the organization of special agencies designed to assure proper coordination of the total effort. Advocates of the plan had been inclined to talk in terms of "total patterns," and to argue that the traditional plan of organization tended to encourage in any one office too much concern for the performance of a primary mission, such as training, with resultant failure to consider all related problems. The operational staff of 1942 included such traditional offices as those of the Air Surgeon and the Air Judge Advocate. But these did not enjoy the status of the four directorates, which embodied the heart of the plan. Though one of the directorates, that of Personnel, closely followed conventional conceptions, the others showed a difference that will justify some attention to detail.

The clearest evidence of the attempt to apply a concept of "total patterns" to the problem of administration is perhaps provided by the Directorate of Military Requirements. Its subordinate divisions were headed by Directors of Air Defense, Bombardment, Ground Support, War Organization and Movement, Base Services, and Individual Training. Each of the first three directors—of air defense, bombardment, and air support—was expected to act as a coordinating agent in the solution of problems affecting tactics, equipment, and training in his own special field of combat operations. For the accomplishment of this end he could deal with other directors in his own office, such as the Director of Individual Training, or with any other office whose function might affect the solution of a particular problem; his job, in short, was to see to it that all related activities moved apace toward achievement of the goals set by the policy staff in the area of his administrative responsibility. War Organization and Movement, originally planned as a separate directorate, directed the assembly of task forces, prepared troop-movement orders, and allocated aircraft and personnel. The Director of Base Services inherited a complex group of functions which included the allocation of supplies, the determination of technical standards for air bases and facilities, the supervision of air transport, the planning of military air routes, and the maintenance of necessary liaison with other arms and services. The Director of Individual Training worked chiefly with the training commands to assure the maintenance not

only of standards but of balance in the more basic phase of the training program.[14] No comparable provision was made in March 1942 for supervision of the more advanced phase of training. As an afterthought, in May unit training was made a "primary obligation of the entire Air Staff," with responsibility centered in A-3.[15]

A second group of offices, joined together under the Director of Technical Services, dealt with a variety of specialized problems reflecting not only the increasing dependence of aviation on technical aids but also the tremendously enlarged scale of the AAF's operations. Some of the functions had previously developed within OCAC, but other offices were quite new to any U.S. military headquarters. Already, the very size of the air arm's expansion had produced critical problems of traffic congestion and control, problems which required new attention to the regulation of military traffic in coordination with appropriate civilian agencies and in addition introduced a factor of increasing importance in determining the location of additional air installations. For traffic control, and even more importantly, for the direction of combat operations, there were in the field of electronic communications new developments whose vital importance had been clearly established in the Battle of Britain. It had also become clearer than ever before that the success of air operations depended upon accurate forecasts of weather conditions the world over. The AAF faced its global responsibilities, moreover, at a time when much of the world remained to be charted and mapped with the aid of aerial photography and for the special guidance of the airman. And so largely did air operations depend upon technical equipment that normal military inspection had to be supplemented by special inspections by men who had technical knowledge. Consequently, the Directorate of Technical Services included directors for Communications, Weather, Photography, Technical Inspection, and Traffic Control and Regulations. This last was divided in May 1942 into the Directorate of Civil Airways and the Directorate of Flying Safety.[16]

The Directorate of Management Control represented a significant attempt to apply some of the methods of modern business to a large military organization. Since the beginning of the Air Corps' expansion in 1939 it had become increasingly evident that older methods of reporting and inspection, however well suited to the needs of the smaller air arm of the 1930's, could not provide the information and

the degree of over-all control that was essential to a properly functioning headquarters. Early in 1941 the OCAC Plans Division had established an organizational control and administrative unit for the correlation of statistical information and for study of organization and procedures within the Air Corps. A statistical section was added at the Air Staff level in June 1941, but its statistics, as one might expect, did not always agree with those compiled in OCAC or AFCC. In the fall of 1941 Col. Byron E. Gates established in the Plans Division an administrative planning section employing civilian administrative analysts who were authorized to review Air Corps procedures and to recommend correction of any deficiencies found. This action received a strong indorsement in a study completed in November 1941 by a firm of management engineers, the Wallace Clark Company, whose survey emphasized the need for better statistical reporting, standardization of administrative procedures in accordance with the latest business practices, and the development of new techniques for control of all phases of the air program.[17] It was against this background that the March 1942 reorganization brought together under Management Control the Directors of Organizational Planning, Statistical Control, Legislative Planning, and, in addition, the Air Adjutant General.

At the center of the new Management Control stood the two offices of Organizational Planning and of Statistical Control. The former studied administrative procedures and prepared flow charts of AAF activity with a view to recommending necessary reforms or reorganizations; it also coordinated all administrative publications. Statistical Control undertook to consolidate and systematize all statistical reporting so as to provide for staff purposes information that was not only full but which facilitated comparative studies. For this last purpose, it was necessary that the data be based upon a uniform system of reporting. The methods employed are perhaps best suggested by the newly developed AAF Form 127, which became the basic report for statistical information on personnel. Required at regular intervals from all AAF units, this form reported all personnel both by military specialty and unit assignment. Prepared in multiple copies for transmission through channels, the report gave some assurance that all echelons of command would base their studies on the same statistics. By providing comparable data for every unit of the AAF, Form 127 greatly facilitated the prepara-

tion of over-all analyses. Similarly, the daily inventory of aircraft (AAF Form 110) was used as a source of information for determining advance requirements as well as the most effective distribution of equipment on hand. During the latter half of the war Statistical Control undertook through AAF Form 34—a report listing for each mission such items as the number of planes employed, the flying time, the bomb tonnage dropped, the total of ammunition and fuel consumed, and the losses sustained or inflicted—to replace fragmentary and uneven reports from combat theaters with uniform world-wide operational statistics. A special dividend for historians came at the end of hostilities in the Army Air Forces Statistical Digest, a publication of December 1945 which summarized in as accurate and complete a form as can be hoped for the statistical record of the war years.[18]

As the work of Management Control suggests, the Air Staff displayed from an early date a marked inclination to borrow heavily from the experience and skills of the civilian community it served. This is explained in part by sheer necessity, a necessity which affected all of the services in their attempts to keep up with programs of expansion quite literally conceived on unprecedented scales. But no other arm or service expanded during the war years at the rate forced upon the AAF. With a mere handful of regular Air Corps officers and a thousand different places at which their experience was at a premium, only a few of them could be held for staff work at Headquarters. This was especially true after the spring of 1942, when the demand for experienced leadership in newly forming combat commands drew heavily upon the small staff of regulars who had shaped the Air Corps' expansion from 1939 through 1941.* Other branches of the Army helped to make up the deficiency, but the expanding staff at Headquarters necessarily recruited its strength mainly from civilian life. Some of those recruited were veterans of World War I, some had experience with the National Guard, some were reservists of one arm or another, some were regulars called back from retirement, and some enjoyed the limited advantages of a peacetime ROTC course of study in college. Many were commissioned directly from civilian life without any military back-

* For example, Eaker, Spaatz, Kuter, and Hansell transferred their attention to combat operations against the European axis in 1942, and General George took the responsibility for a rapidly developing air transport system.

ground whatever, and some of the more influential elected to remain in a civilian status. But whether in uniform or out of it, staff members took up their tasks with points of view that were only here and there colored by any long association with military usages. At the top of any office one usually found a regular—and usually, let it be said, a man who knew how to get along with civilians—but below that level there were multiplying opportunities for speculation on whether the colonel was in "real life" a Buffalo lawyer, a Cleveland executive, a California politician, a New York public relations counselor, or just a college professor.

The very novelty of many tasks thrust upon the AAF encouraged heavy borrowing from the experience of nonmilitary organizations. There was, for example, no military model or parallel for the development of a world-wide system of air transport, but the experience of the civilian airlines constituted a source of talent that was drawn upon heavily. It should be noted, however, that experience in a civilian type of activity could be a limiting factor on the usefulness of an individual unless he was able to adjust his thinking to the special demands of a military effort. Thus, the Air Transport Command faced many of the problems of any other airline, but in the speed of its development, in the scale of its operations, and in its emphasis on the movement of freight rather than passengers, it was definitely unprecedented. Similarly, the air service organizations of the AAF encountered many of the problems of a giant industrial concern, and could use profitably, for instance, methods and techniques developed by American industry for stock accounting on some 600,000 different items of equipment and supply. But cost rationales which shaped the pattern of business procedures had to give way to new concepts founded on military urgency. A railroad executive might prove most helpful to an intelligence office plotting a bombing campaign against enemy transportation systems, but only if he could think in terms of the factors which govern a military, as distinct from the normal, employment of railway facilities. An educator, to mention one other example, could bring valuable experience to the problems of training, but he too had to make drastic adjustments in older habits of thought. The very scale of the AAF training program and the schedules it had to meet demanded the fullest exploration of new techniques for the classification and instruction of students. For the academician, perhaps the most drastic adjustment of all was to get

away from a sense of the limitations normally imposed on educational methods by academic budgets.

Fortunately, the AAF itself was predisposed in favor of an experimental approach. Though its top leaders were in most cases West Point graduates, their long identification with the Air Corps, which had regarded itself as the victim of an entrenched conservatism in the General Staff, encouraged a view of themselves as advocates of new approaches to military problems. Though the youthfulness of the AAF's generals was much overplayed in the popular mind, the organization itself was new and its attitude was basically youthful, in the sense of not being overly bound by conventional ways of doing things. This was in part due to the outlook of the aviators, who at all echelons of the AAF occupied the key positions. The pilot, whatever his limitations when outside the cockpit, owed the very existence of his vocation to a revolutionary technological development that obviously had not yet run its full course. He had been closely associated with experimental developments in aeronautics and had shared with many men outside the Air Corps the excitement of new achievements in this field. He was thus conditioned by experience to accept the proposition that the United States Army had no monopoly of useful knowledge.

The American airman entered the war with a rather well-developed body of doctrine on how the airplane should be employed. In addition to its role in support of other arms, air power, he believed, had its own independent mission. That mission emphasized the capacity of the airplane to strike directly, given the necessary bases, at the enemy's "national structure" for the purpose of destroying both his will and ability to wage war; it was also understood (and the earliest operational experience in the Pacific tended to stress the point) that to get at the "national structure" it would first be necessary to win control of the air by defeating the enemy's air force.* The accomplishment of this preliminary objective may have seemed at the outset to call for nothing more than the necessary forces and for intelligence in their employment, but it was evident from an early date that the AAF was poorly prepared for waging a strategic campaign against Germany, or any other enemy, because of the paucity of organized intelligence on the target itself. Prewar attempts to set up priorities for certain cate-

* See especially Vol. I, 51–52.

gories of targets stood the test of combat surprisingly well,* but experience had brought an early appreciation of the need for a more scientific approach to the problem of target selection. A notable step in this direction came in December 1942, when a special Committee of Operations Analysts (COA) was established by Arnold's order in Management Control.[19] The designation actually was intended as a cover; for the committee, whose true function was target selection, was concerned only incidentally with the analysis of operations. Two features of its organization and procedure merit special note: it combined regular members of such staff offices as A-2 with a distinguished group of civilian experts, and its investigations represented a conscious attempt to apply scientific procedures to the problem of target selection. The committee borrowed heavily from the resources of a variety of intelligence agencies, both British and American, but the Combined Bomber Offensive plan adopted as a guide to the Eighth Air Force's expanding strategic operations against Germany owed its essential character to the work of COA.† In the spring of 1943 the committee, somewhat enlarged to provide representation for the Navy, turned its attention to a study of Japanese targets in preparation for the B-29 offensives.‡

As the war progressed, it became increasingly evident that the scientific analyst had a no less important part to play in the development of combat tactics. This was particularly true of strategic bombing operations, where the need for a check on the effectiveness of any one mission, or of a particular tactic employed, early led to provision for consolidated reports which presented with increasing fullness pertinent operational data on missions flown. As early as October 1942, civilian experts trained in statistics and other analytical disciplines had been put to work by the Eighth Air Force in the Operational Research Section,§ whose designation and function had been adapted from the practice of the RAF.[20] Every mission in a hitherto uncharted field of warfare, experience showed, was in greater or lesser degree an experimental venture to which the techniques of quantitative analysis could make a well-nigh indispensable contribution.[21] Not every combat commander was as prompt as Eaker had been to sense the importance of operations analysis. Some were inclined instead to rely on a general rule of hitting the enemy somewhat indiscriminately with

* See Vol. II, 368–69.

† See Vol. II, 348–67.

‡ See Vol. V, 26–27.

§ See Vol. II, 225.

"everything in the book."[22] But Arnold, who became fond of admonishing his staff that the "long-haired boys" could help, established an operations analysis section in Management Control at AAF Headquarters in October 1943 under the leadership of Col. W. Barton Leach, a peacetime member of the Harvard law faculty.[23] Through this office other air forces were encouraged to take advantage of evaluation techniques that had been more familiar in the laboratory than on the battlefield but to which Arnold paid a warm tribute after the war.[24]

In running thus ahead it is not intended to suggest that the basic organization of AAF Headquarters had been permanently fixed in the spring of 1942. On the contrary, there had quickly developed a strong and growing dissatisfaction with the fundamental principle on which the staff at that time had been organized. A-staff sections tended to complain that they were hampered in their efforts at shaping policy because they lacked information on current operations; the directorates objected that failures in planning all too frequently put them into the business of policy-making "according to their individual ideas."[25] Many came to suspect and then to be convinced that the distinction between policy and operating staffs was an artificial one. They found coordination difficult because of trouble in pinning down ultimate responsibility. Field agencies, too, complained that the organization was complex and confusing. In July 1942 the First Air Force attributed twenty-five instances of misinformation received by it to the confused channels of the Washington headquarters. Other field organizations protested that the policy of decentralized responsibility for operations was being defeated by the tendency of the directorates to give orders in too great detail. Lovett called a special meeting in September 1942 which resulted in some adjustments. Management Control was given policy-staff status at that time, and several offices—those of the Air Inspector, Air Judge Advocate, Air Surgeon, Budget and Fiscal, and the Director of Flying Safety—were designated as special staff sections. But these adjustments did not strike at the root of the difficulty, and dissatisfaction continued. Detailed studies at Headquarters, supplemented by suggestions brought back by General Arnold from a world tour, led to a major reorganization.[26]

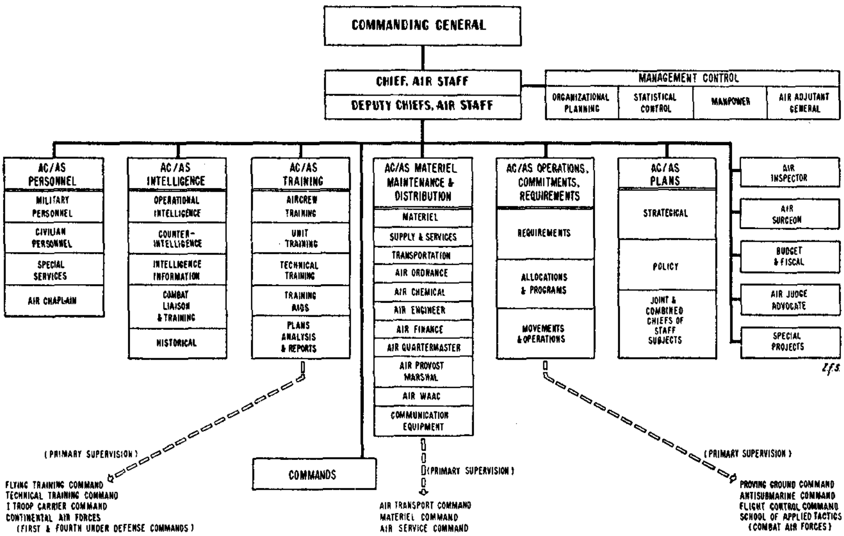
The new plan, which went into effect on 29 March 1943, abolished the directorates and combined policy-making with the control of operations in reconstituted A-staff offices. It was expected, however,

that the degree of operational control exercised by Headquarters would be reduced to a minimum. The AAF program on the home front was approaching its peak, and the need for greater decentralization of controls had undoubtedly contributed to the decision to reorganize. Arnold warned the newly arranged staff that it "must stop operating" in order to concentrate its energies on the development of clear-cut policies that would tell subordinate commands what to do and sometimes when to do it, but never how to do it.[27] Most of the surviving Headquarters organizations were now regrouped under one of six offices, each headed by an assistant chief of air staff: Personnel; Intelligence; Training; Materiel, Maintenance, and Distribution (MM&D); Operations, Commitments, and Requirements (OC&R); and Plans. Management Control, the only one of the original directorates to survive the reorganization, was attached directly to the office of the Chief of Air Staff to assist him in his duties as the head of administration under Arnold. In the shift Management Control lost its legislative planning function but acquired a Manpower Division charged to eliminate overlapping within the AAF of agencies concerned with personnel functions. In August 1943 the Administrative Services Division took over many of the duties formerly performed by the Air Adjutant General, and in October, as previously noted, Management Control acquired an Operations Analysis Division. Maj. Gen. George E. Stratemeyer, who had presided over the studies which gave shape to the new organization, continued to serve as Chief of Staff for a few more weeks prior to his assignment to a combat command in CBI during the summer of 1943. His place was taken by Maj. Gen. Barney M. Giles. There were three deputy chiefs of staff in 1943, and four from 1944 on.

The six assistant chiefs of staff held responsibilities that were reasonably well indicated by the names of their several offices. AC/AS, Plans, under Brig. Gen. Laurence S. Kuter, who took command in the summer of 1943, became even more influential than it had been before. Having served with the 1st Bombardment Wing of the Eighth Air Force and having more recently participated in the moves leading toward the establishment of the Northwest African Air Forces, Kuter was one of the first key AAF officers to be brought back from a combat zone for an important assignment at Headquarters. Under Kuter AC/AS, Plans gave multiplying evidence in its major activities of the fundamental shift of emphasis which came in the AAF's war effort

with the year 1943. Theretofore, planning at Headquarters necessarily had centered on the problems of recruiting, training, equipping, and organizing the forces with which to fight. But as the training program, for example, reached and passed its peak in 1943, Headquarters directed its own energies increasingly to the support and, not infrequently, to the direction of combat operations overseas. No organizational chart quite managed to convey a sufficiently strong impression of the central importance of AC/AS, Plans. Its staff, though strength-

AAF ORGANIZATION, 29 MARCH 1943



ened by the addition of officers who had fulfilled their quota of combat missions overseas and who knew at first hand combat conditions in the several theaters, remained small. But it was well understood throughout Headquarters that Plans operated closer to the center of power than did any other parallel office. Its theater sections, not to mention the special JCS section, which held custody of Arnold's records as a member of the Joint and Combined Chiefs of Staff, served to remind those who needed the reminder that Arnold's command was not restricted to the Zone of Interior.

OC&R took over many of the duties of the former Directorate of Military Requirements, but its job was more sharply defined. It superintended the Proving Ground Command in Florida, where tactical

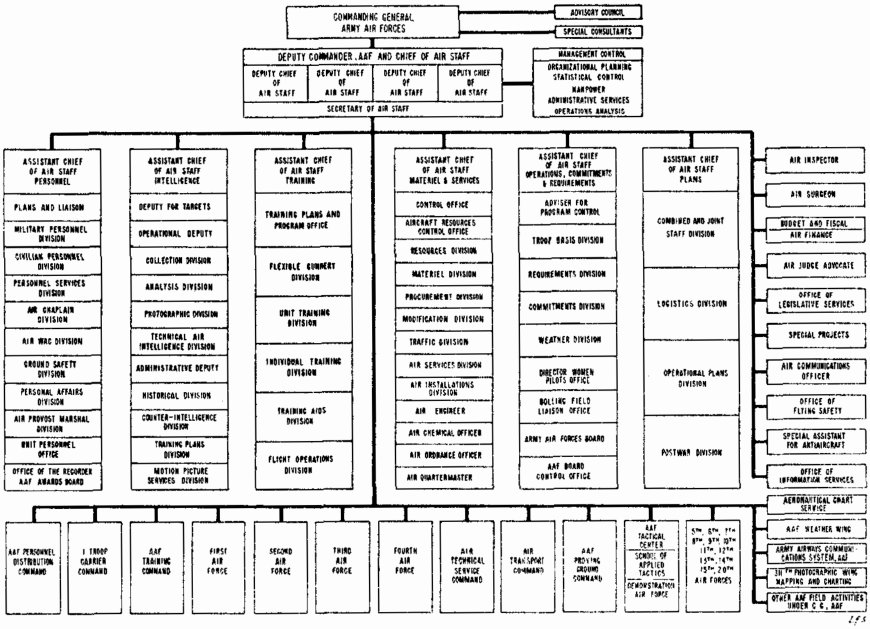
equipment and tactics themselves were tested under simulated battle conditions. It was responsible for the School of Applied Tactics, also in Florida, for the special problems of the Antisubmarine Command during its short and troubled history, and for the Flight Control Command. But the burden of its job was superintending the organization and movement of air units overseas; for all the varied units which made up an air force it set up standard tables of organization and equipment. To accomplish its ends, the office had to work closely with OPD in the War Department. Similarly, AC/AS, Personnel had repeated occasion to coordinate with G-1. AC/AS, Intelligence devoted itself to the collection, evaluation, and dissemination of information bearing especially on the problems of air warfare. It also controlled counterintelligence activities within the AAF and the AAF's historical program. AC/AS, Training gave centralized direction to the Flying Training and Technical Training Commands, and to the training activity of I Troop Carrier Command and the four continental air forces. MM&D, which became AC/AS, Materiel and Services on 17 July 1944, was the Headquarters office for the Air Service, Materiel, and Air Transport Commands. Charged with special responsibility for equipment and supplies peculiar to air units, it worked closely with Army Service Forces on many questions of common interest and dispute, including those involving the so-called common use items of supply.

As usual, there were a few somewhat specialized functions which could not be readily fitted into the general scheme of organization, or which for a particular reason needed to be kept close to the top level of command. The accompanying chart indicates their several designations. Three new special staff offices were added in October 1943: Flying Safety, a Headquarters agency for the Office of Flying Safety at Winston-Salem, North Carolina; a Special Assistant for Antiaircraft; and the Air Communications Officer, whose duties were enlarged after October 1944, when the AAF took over from the Signal Corps responsibility for developing and maintaining air communications equipment. In December 1943 the Office of Legislative Services was also added for liaison with Congress and to review proposed legislation affecting the AAF.[28] Except for a subsection in the War Department Public Relations Office, the AAF had gone without a PRO of its own, but a Technical Information Division under AC/AS, Intelligence had served partly to plug the gap. This division was sepa-

rated from Intelligence and elevated to special-staff status in the spring of 1944, and in November it was redesignated the Office of Information Services.[29]

With little significant change the organization established for AAF Headquarters in the spring of 1943 served until after the war. No military headquarters, of course, can long endure a continuing dependence on an old T/O; the redrawing of organizational charts and the re-

ORGANIZATION OF THE ARMY AIR FORCES



shuffling of familiar functions seem an almost indispensable part of the military way of life. But the changes made after March 1943 had their principal effect on the internal structure of the several offices, and many of them were of slight importance. Of more significance was the continuing effort to reduce the load carried by Headquarters through consolidation of subordinate commands reporting to Washington, as in the creation of a single Training Command in 1943, in the union of materiel and service agencies under the Air Technical Service Command in 1944, and in the establishment of the Continental Air Forces in May 1945.*

* See below, pp. 63–65, 75.

Even so, Headquarters still displayed the normal tendency of government agencies to grow. Contributing to this expansion were some instances, no doubt, of empire-building, but there were more important causes. Considered simply as an organization whose task was to recruit, train, and equip forces for combat, the AAF reached the peak of its operations in the winter of 1943–44, and the burden falling upon Headquarters should have tapered off thereafter. But this was far from being the case. Indeed, the moves instanced immediately above to lighten the responsibility for Zone of Interior activities served chiefly to free Headquarters for attention to other pressing business. With the acceleration of combat operations in all quarters of the globe and with multiplying demands upon Arnold for the means to exploit developing opportunities, AAF Headquarters increasingly assumed the responsibilities of an office exercising very real prerogatives of command over world-wide operations. On the constitution of the Twentieth Air Force in April 1944, AAF Headquarters literally doubled as the operating headquarters for the new force,* and much of the energy which had made a success of the B-29 "crash program" was generated by Arnold's staff. Moreover, the fact that the war had to be won first in Europe and then in the Pacific forced Headquarters to give painstaking attention to complex problems in the redeployment and the reequipment of units after V-E Day. And withal, the changing status of the AAF vis-à-vis its sister arms and services, not only added to the complexities of day-to-day procedures but also raised new questions of policy in long-range planning. There was work enough to do.

It is difficult to determine a proper standard against which to judge the quality of staff work at Headquarters. Examples of confusion, of overlapping jurisdiction, of waste, of empire-building, and of personal failures to measure up to requirements would be easy to point out. But how much this would prove is debatable, for all such instances could be balanced and more than balanced by contrary examples. There were critics at the time who felt that the AAF never quite whipped the problem of establishing effective controls over its diversified programs; a Program Control Office functioned in OC&R, but it was felt that this office should have been placed on a higher echelon.[30] This may well have been true. But the final test would seem properly to be the measurement provided by over-all accomplishment, and on

* See below, p. 55.

that score the verdict has to be favorable. Neither this nor any other headquarters could claim to have won the air war, but it must be admitted that AAF Headquarters was in a peculiarly strategic position to make a major contribution to losing it. Instead, Arnold's staff, beginning in 1938, gave shape to programs, not only unprecedented in scale but lying largely in hitherto uncharted fields of warfare, that stood the test of battle remarkably well. They were also completed on schedule, as nearly as anyone reasonably could have asked. Moreover, the AAF, while contributing significantly to two great military victories as one member of an interservice team, did so without sacrificing progress toward the achievement of its own distinct ambitions. This record on its face suggests staff work of high quality.

Topside Relations

Before turning to the channels through which the AAF accomplished its primary mission, there may be some interest in retracing the steps by which it won recognition as virtually a third independent service. That status, as previously noted, had no recognition either in law or in the War Department regulations which defined the basic relationships of the constituent parts of the Army. The chief of these regulations, that of 2 March 1942, could have been read to mean that the AAF had been limited, at least for the duration of the war, to a subordinate role. At the very time of its writing, however, the head of the AAF had already attained a position in the top war command that profoundly affected the status of the organization he represented. Fortuitous circumstances were partly responsible, the chief of them being that the British had adopted a threefold division of their armed services—air, ground, and sea—as the basic principle governing their military organization. That fact, plus the inescapable importance of air operations in all existing war plans, argued strongly for representation of the chief U.S. air arm among the top military advisers to the Commander in Chief, especially when consultations were held with the British Chiefs of Staff. This necessity had been foretold as early as the Atlantic conference of August 1941, when Arnold accompanied Roosevelt to his historic meeting with Churchill. When Churchill and the British chiefs came to Washington just after Pearl Harbor for consultation with Roosevelt and his advisers, Arnold again was given an important part in the discussions. As he himself later put it: "From that time forward, there was no doubt about the Commanding Gen-

eral of the Army Air Forces being a member of the President's Staff."[31]

These discussions of December 1941–January 1942 quickly took on a pattern destined to be followed subsequently, as Arnold joined the Chief of Staff and the Chief of Naval Operations in consultations on proposals from, or to be made to, the British chiefs in combined sessions.* At the suggestion of the British on 10 January 1942, it was agreed to establish a permanent inter-Allied organization representative of the military staffs of the two nations.[32] Out of this proposal came the Combined Chiefs of Staff with permanent headquarters in Washington, where the British chiefs normally depended upon representatives assigned for the purpose. The public in both countries gained their knowledge of the organization chiefly through the major high-level conferences of 1943–45, attended by both Roosevelt and Churchill, at which the two groups of staff chiefs consulted on major issues of strategy and resources. It was through the permanent organization, however, and especially through the work of its subordinate committees, that the ground was cleared for those agreements which made of the Anglo-American war effort an unprecedented example of a successful military coalition. But the purpose here is not to describe the development of an extraordinary experiment in international relations, but to point out the significance of the fact that the AAF enjoyed representation at this top level of command on a par with the RAF and, for all practical purposes, on a par with the U.S. Navy and the U.S. Army.

The CCS by its very existence virtually made inescapable some new organization of the U.S. chiefs of staff. That need was met by the Joint Chiefs of Staff, whose formal meetings dated from 9 February 1942. It would be a mistake to assume that the JCS owed its existence solely to the need for consultation among the American chiefs in preparation for sessions with their British counterparts, for the conditions of modern warfare imposed upon all services a new necessity for the closest cooperation. Undoubtedly, the Joint Board, prewar agency for coordination of Army and Navy activity, would have undergone some significant development of function even had there been no close alliance with the British. Whether the AAF in such a development would have promptly won representation comparable to that of the Army and the Navy is another question; but it

* See Vol. I, 237 ff.

did win such representation on the JCS and on the subordinate committees which paralleled in function and organization those of the CCS. That President Roosevelt appreciated the significance of this fact was made clear in a letter he wrote to Senator McCarran in 1943: "My recognition of the growing importance of air power is made obvious by the fact that the Commanding General of the Army Air Forces is a member of both the Joint and Combined Chiefs of Staff."[33]

The success of the Joint Chiefs came from a "will to agree," rather than from any clear definition of powers or of procedures. It would be misleading to speak of Arnold as having a vote; what he had was a voice in the discussions through which agreement was reached. Adm. William D. Leahy, who in the summer of 1942 was made a fourth member as the President's personal chief of staff, later described the Joint Chiefs as "just artisans building definite patterns of strategy from the rough blueprints" of the Commander in Chief.[34] But day-by-day planning often molds ultimate strategies, and the Joint Chiefs were in a very real sense the coarchitects, with their British colleagues, of the plans which produced victory. Robert Sherwood, in *Roosevelt and Hopkins*, has suggested the role of the Joint Chiefs in this passage: "Churchill soon learned that if he wanted to influence American strategic thinking, as he often did, he must do his arguing with the generals and admirals."[35] Among those he had to persuade was Arnold.

Perhaps too much stress can be placed on the simple fact of Arnold's membership in the JCS. In any event, he undoubtedly would have had representation in the work of JCS agencies, just as did Navy airmen on the Joint and Combined Staff Planners,* the key committees for strategic planning.[36] Not only would he have had such representation, but there is reason to believe that the attitude then prevailing in the War Department, which showed an increasingly marked contrast to Navy opinions with reference to its own air arms,[37] would have assured for him an influence comparable to the importance of the arm he commanded. Since the fall of 1940 he, or his chief of staff, had presided over the Joint Aircraft Committee, the earliest forerunner of the system of combined staff agencies. Its critically important function of allocating U.S. aircraft production among the several

* It should be noted, however, that the presence of Navy airmen served partly to preserve a balance between Army and Navy representation which seems to have been important to the Navy Department.

claimants, including the British and the Russians, became even more important with the U.S. entry into the war and as the committee's duties were absorbed by the Munitions Assignments Board established in February 1942, with powers over British as well as American production.* Already at that time Arnold had hammered out an agreement with ACM Sir Charles Portal on the relative claims of the RAF and AAF that was accepted by the new board as a basis for production planning.† In short, the central importance of aircraft to U.S. war plans had long since given to Arnold a place, however ill defined, among the top commanders.

At the time of the War Department reorganization in March 1942, it was planned that the General Staff henceforth should be evenly divided between ground and air officers. This objective was never realized, apparently at the election of the AAF itself,[38] but the number of AAF officers assigned to duty with the General Staff did increase to a point that an organization such as OPD acquired something of the character of a joint staff agency.[39] Col. St. Clair Streett became one of the two deputy chiefs of OPD under Eisenhower in the spring of 1942 and later in the year (then a brigadier general) served as chief of OPD's influential Theater Group, a post assumed in the fall of 1944 by another air officer, Maj. Gen. Howard A. Craig.[40] Such assignments, like that of McNarney as Marshall's deputy, gave expression to the latter's hope that special representation for the air force might be combined with unity of command. AAF Headquarters was thought of as an expert staff for the advice of the General Staff on questions affecting air operations, but the power to issue operational directives lay in the jointly manned OPD, which in turn looked to the AAF for implementation of directives issued with its advice. The AAF was thus bound to clear through OPD its own decisions on such matters as the assignment and movement of air units overseas.

It was through OPD also that the AAF got at least some of its representation on JCS agencies. This point, however, can be too finely drawn. In the early development of the JCS machinery, circumstances and practical needs had more to do with the organization and functioning of the several committees, many of which were *ad hoc* in origin, than did any directive, fundamental charter, or like paper. There was a job to be done, the pressures to get on with it were great, and no

* See Vol. I, 129, 256–57, and below, pp. 292, 404.

† On the Arnold-Portal agreement of 13 January 1942, see Vol. I, 248–49.

one questioned that Arnold should be represented in discussions affecting his own arm, as indeed did practically every question before the Joint Chiefs. If the air officers attending a committee meeting came from OPD and at its direction, as in the Joint U.S. Strategic Committee,[41] their presence conformed more closely with the legal basis of War Department organization in 1942. But rules on membership in the committees, insofar as rules existed, tended to be very flexible. The working members of any committee were as likely as not to be representatives of the staff offices immediately concerned with the questions at issue.

It should be noted, too, that the influence of JCS organizations on the shaping of policy and strategy was not so great in 1942 as it later became.[42] Marshall himself carried much of the burden, as is suggested by his two personal missions to England in April and July of that year (the second time accompanied by Admiral King) in quest of an agreement with Britain on operations against Germany. If Marshall depended chiefly on OPD for the staff work to lighten his burden, he also leaned heavily on Arnold in ways that tended to emphasize not so much the subordination of Arnold's staff to OPD as it did their parallel responsibilities. In the forces which the United States could promise to commit in support of its argument for an early offensive against Germany no other element loomed larger than did the air component which Arnold bent his every energy to get deployed as quickly as possible.* When the decision went against Marshall and plans for a North African operation threatened to undermine the whole concept of an initial concentration against Germany, the issue turned largely on a question of air deployment. It was settled, as Marshall had hoped to have it settled, on the basis of information provided by Arnold and Streett, then chief of OPD's Theater Group, as the result of a special mission to the Pacific theaters in the early fall of 1942.† In the long and bitter conflict which developed between the AAF and the Navy over the employment of land-based aircraft against German submarines, AAF Headquarters, OPD, and Secretary Stimson's own office worked in the closest collaboration without

* This is not to overlook Arnold's own interest in seizing the best opportunity he had to mount a strategic bombing offensive. The whole subject of strategy and deployment against Germany has been discussed in Volumes I and II.

† See the admirable discussion of this entire question in Maurice Matloff and Edwin M. Snell, *Strategic Planning for Coalition Warfare, 1941–1942* (Washington, 1953), especially pp. 320–23.

much regard for channels, except that Stimson and Marshall lent their every aid in pressing upon King the advantage that might be gained through adopting doctrines developed by the AAF.* Other examples might be noted here, but perhaps enough has been said to support the proposition that the War Department was coming to rely on two policy-making staffs. The one staff was more specialized than the other, but it was hardly so subordinate to the other as regulations and standard procedures might suggest.

When the U.S. chiefs undertook to strengthen the organization of the JCS after an unhappy experience at the Casablanca conference of January 1943 had demonstrated the superiority of British staff work,[43] the AAF scored additional gains. Membership in the Joint Planning Staff (JPS), which continued to serve as the key committee through which the work of other committees was channeled to the JCS, came in the spring of 1943 to have a fixed identification with particular staff offices in the two services, Arnold being represented by his AC/AS, Plans.[44] The point may be a small one, but it is worth noting that Arnold was represented in the same way as was Marshall, for whom the chief of the OPD Strategy and Policy Group regularly spoke. Three of the six officers designated by OPD for service as planners under the newly established Joint War Plans Committee (JWPC) were air officers; what is more significant, these three were shortly transferred out of OPD to AC/AS, Plans.† The committee itself functioned under the leadership of three senior planners, or directors, representing the Army, Navy, and AAF. Its charter indicated equal representation below this level for the Navy and the Army, including its air force, but JWPC "actually conducted most of its business on the principle that there were three separate spheres of special knowledge, as represented by the three directors."[45] On other committees of the JCS, which served with their British opposite numbers to provide the organization through which the CCS worked, the AAF henceforth also enjoyed what could be described as independent representation.

This fact has a significance transcending mere questions of War Department policy, important as that was for its effect on the AAF's position. A major result of the greatly strengthened organization of

* See Vol. I, Chap. 15, and Vol. II, Chap. 12.

† Compare above, p. 52, the earlier rule with reference to the Joint United States Strategic Committee.

the JCS was to give into its hands a far greater control over the deployment and operations of U.S. combat forces than theretofore. In the earlier part of the war the JCS and its committees had served perhaps chiefly for the clarification of differences that were finally resolved through correspondence or by verbal agreement between Marshall and King, who had an unmistakable and understandable preference for dealing with Arnold through Marshall.* But after the spring of 1943 the final decisions increasingly were reached by an organization in which, at every echelon, Arnold or his representatives had to be dealt with directly. Not only that, but the transfer of power to a joint staff in which Arnold had an equal voice with the other two chiefs encouraged practices that made of the AAF an independent agent for the execution of JCS decisions.

In this last development it would be difficult to exaggerate the significance of the fact that the AAF had its own independent combat mission to perform. The strategic bombardment of Germany undertaken by the Eighth Air Force had no place in U.S. war plans except as a preliminary to an amphibious invasion of western Europe. Moreover, it was well understood that the strategic forces committed to this preliminary air phase of the offensive against Germany would pass at an appropriate time to the command of the officer responsible for the invasion. Indeed, the Eighth Air Force had been set up in 1942 with an organization in which Eaker's VIII Bomber Command was balanced by an air support command for tactical operations in support of ground troops, and the whole air force had come as a matter of course under Eisenhower's command upon his assignment to the European theater in the summer of 1942. But Eisenhower was sent against the Germans in Africa (TORCH) in the fall of that year as a result of decisions which indefinitely postponed a cross-Channel attack on western Europe. Only the somewhat depleted Eighth Air Force remained in Britain to fulfill an earlier hope that Germany might be subjected to an immediate and direct attack. Though the AAF had strongly opposed the decision in favor of the landing in northwest Africa, it nevertheless gained an advantage by it. At the Casablanca conference in January 1943 the CCS, while deciding on an invasion of Sicily as the logical sequel to TORCH, authorized a combined bomber offensive by the Eighth Air Force and RAF Bomb-

* See again the procedures followed in the discussion of antisubmarine warfare, as presented in Vols. I and II.

er Command against Germany, and for its direction Sir Charles Portal was subsequently designated as executive for the CCS. In actual fact, no combined offensive, in the sense of a closely integrated RAF and AAF effort ever developed, and the Eighth Air Force's part in the campaign was run by Eaker and Arnold, and after December 1943 by Spaatz and Arnold. The Eighth Air Force passed to the control of Eisenhower on the eve of the Normandy invasion, but it was returned to the CCS in September 1944, which is to say that in effect it was returned to the AAF.*

The precedent thus established stood the AAF in good stead when the control of B-29 units came into question. Used entirely against Japan, deployment of the B-29's required no reference to the Combined Chiefs, except such as was dictated by considerations of courtesy. The question of its direction was settled by the Joint Chiefs, who made Arnold their executive agent in command of the Twentieth Air Force.† War Department regulations governing AAF activities beyond the Zone of Interior were amended in April 1944 to authorize Arnold to "implement and execute major decisions of the Joint Chiefs of Staff relative to deployment and missions, including objectives, of the Twentieth Air Force."[46] AAF Headquarters assumed a dual role, with each member of Arnold's staff doing his normal job for both the Twentieth Air Force and the AAF. In fact, this was too much to expect of an already heavily laden staff, and Arnold exercised his command chiefly through a special chief of staff, who was first Brig. Gen. Haywood S. Hansell, Jr. The experiment proved none too successful, and the command of B-29 operations passed in the summer of 1945 to the U.S. Army Strategic Air Forces in the Pacific under Spaatz. General Spaatz had commanded the U.S. Strategic Air Forces in Europe from January 1944 until after V-E Day, a command joining administrative control of the Eighth and Ninth Air Forces in England and western Europe with operational control of the Eighth and Fifteenth Air Forces, the latter of which operated from Mediterranean bases. Thus, by JCS and CCS decisions which Arnold helped to shape, the AAF had won a high degree of independence in the direction of strategic air operations.

* The story is recounted in detail in Vols. I, II, and III. It should be noted that after September 1944 Spaatz shared with Portal the assignment as executive of the CCS in the development of strategic bombing against Germany.

† See Vol. V, Chap. 2.

These developments created a multitude of twilight zones in which the interpretation of traditional responsibilities proved difficult. In Washington there were questions that had to be ironed out with other Army agencies, especially OPD; in the combat theaters the AAF's tendency toward an increasing self-sufficiency produced comparable difficulties over questions of bases and supply as well as of operational control. It would be hard to make any general statement on how these problems were resolved, without serious injury to the common war effort, except that the helpful personal relationships existing between air and other commanders, as with Eisenhower and Spaatz or MacArthur and Kenney, played an especially significant part. And to this might be added one other statement: organizational relations overseas were powerfully influenced by those at home.

Arnold from the very beginning had enjoyed a right of direct communication with his air commanders on technical air force problems, a terminology which became subject to a broadening interpretation. Operating his own message center in the Pentagon and possessing in every plane taking off from Washington for an overseas destination a channel of direct and informal communication with his combat commanders, he could notify them immediately of JCS and CCS decisions and could make suggestions for action. As early as October 1943 the AAF had been authorized, on OPD's recommendation, to take directly to the JCS any matter "which the Commanding General, Army Air Forces desires to transmit directly to the Joint Chiefs of Staff in his capacity as a member of that committee."[47] The new procedure saved much time and trouble by contrast with the old, which required routing through OPD, but it set the stage for a relationship between that organization and AAF Headquarters that has been well described by the historian of OPD as depending upon "the principle of opportunistic exploitation of any and all channels leading to joint decisions."[48] Similarly, the delays which naturally developed in any attempt at a three-way coordination of papers among JCS, AAF, and OPD agencies encouraged the air force to "proceed on its own authority to deploy AAF units to meet strategic requirements."[49] OPD protested more than once, and any AAF officer carrying a routine paper, especially if its purpose was to further his own interest, ignored the standard procedures at some risk. But it was clear enough that Arnold himself could act on his own, and that coordination with OPD and other War Department agencies was ever becoming more of a question of mere courtesy.

The year 1943 is so obviously the turning point in these developments that it may be worth noting another victory the AAF gained on 21 July of that year. In a new field manual (FM 100-20, Command and Employment of Air Power) the War Department made official a doctrine already adapted from British experience in the Middle East to the requirements of air combat in northwest Africa. "Land power and air power," read the new manual, "are coequal and interdependent forces: neither is an auxiliary of the other." This doctrine thereafter exercised a growing influence on the spirit of War Department administration.

Operating Agencies

Although after 1943 the AAF's major concern was with combat operations, its first task, and one that had a continuing importance, was to provide the air combat forces to be employed overseas. Considered in its simplest terms, this task involved the recruitment of hundreds of thousands of young men with a natural aptitude for a very wide variety of technical assignments, and the procurement in sufficient quantity of aircraft and other special equipment that could measure up to increasingly high standards of performance. After these steps, both of which were of fundamental importance, lay the jobs first of training and then of organizing trained personnel into effective combat teams skilled in the use of their intricate technical weapons. The weapons, moreover, required elaborate provision for their maintenance, and other thousands of men had to be trained and organized for that purpose. Still others had to be prepared, as in any military arm, for the performance of housekeeping and supply functions.

The nature of air operations placed a special premium on the acquisition of individual skills. An air cadet had first to be taught to fly a plane, and the first phase of training was accurately described as individual training. But air combat by the time of World War II had passed far beyond the primitive stage in which success depended heavily upon individual exploits. This war, by contrast with its predecessor, produced few individual "aces," and those few established their claims for the most part in the earliest days of combat, when a handful of men and planes fought desperately for survival. Thereafter, the accent fell on teamwork. Whether the mission was flown in squadron strength or in numbers as high as a thousand planes, the price of survival was cooperation. For the achievement of this teamwork it was necessary to put many hours into advanced, or unit, train-

ing and to build an organization as intricate and as flexible as the weapon it employed.

The very flexibility which characterized air force organization, not to mention its novelty by comparison with the more or less traditional structures of older services, may justify at this point some attempt to define the units out of which air combat forces were constructed. This can be done only at the risk of some oversimplification, for air organization was at all levels extraordinarily variable. The most elementary unit was the aircrew, which could mean one versatile pilot in a fighter plane or eleven men working together in a B-29 bomber.[50] To simplify tactical control, planes might be organized as required into flights of three or more aircraft operating under a flight leader. Such flights normally would be formed from a single squadron, which was the basic permanent organization of AAF combat elements, and which served also as a basic organization for supporting services. The composition of a squadron varied with its mission. Though bearing a numerical designation, as did virtually all AAF organizations up to and including the combat air force, the squadron was further described by function, as in the 36th Bombardment Squadron, the 378th Fighter Squadron, the 51st Troop Carrier Squadron, the 111th Tactical Reconnaissance Squadron, the 21st Weather Squadron, the 422d Night Fighter Squadron, or the 46th Air Service Squadron. Bombardment squadrons were usually further distinguished, according to their equipment, by indication as to whether they were light, medium, heavy, or very heavy bombardment units. Most squadrons operated as part of a group which usually combined three or four squadrons of like function and equipment, but the squadron could and often did operate separately. Moreover, at times so-called composite groups including squadrons of different functions and equipment were formed. Tables of organization set norms for squadron strength according to requirements for the job assigned, but actual strengths differed from theater to theater and from time to time. Combat air squadrons normally had a total strength of from 200 to 500 men. In 1944 plane strength per squadron varied from seven B-29's to twenty-five fighter planes plus reserves,[51] but what the "book" called for often differed widely from what a squadron might actually have. The group, which may be considered as roughly parallel to an Army regiment, was the key unit both for administrative and operational purposes, as is suggested by the fact that the AAF used this unit as the yardstick for

measuring its successive programs of expansion.* By 1945 a group normally had a personnel strength of about 990 officers and men for a single-engine fighter group, or 2,260 for a heavy bomber group. Norms for major types are indicated on an accompanying chart. The group's squadrons usually had done their more advanced training together, and they normally fought as a unit.

Before the war the wing had served as the key tactical and administrative organization through which the GHQ Air Force directed its combat forces. The wing continued to have some utility

NORMS FOR AAF COMBAT GROUPS

FEBRUARY 1945

INCLUDES ALLOWANCE FOR RESERVE

TYPE OF UNIT*	MAJOR TYPE OF PLANE	NUMBER OF PLANES	NUMBER OF CREWS	MEN PER CREW	PERSONNEL TOTAL	PERSONNEL OFFICERS	PERSONNEL ENLISTED
VERY HEAVY BOMBARDMENT GROUP	B-29	45	60	11	2078	462	1616
HEAVY BOMBARDMENT GROUP	B-17 B-24	72	96	9-11	2261	465	1796
MEDIUM BOMBARDMENT GROUP	B-25 B-26	96	98	5-6	1759	393	1366
LIGHT BOMBARDMENT GROUP	A-20 A-26	96	96	3-4	1304	211	1093
SINGLE-ENGINE FIGHTER GROUP	P-40 P-47 P-51	111-126	108-126	1	994	183	811
TWIN-ENGINE FIGHTER GROUP	P-38	111-126	108-126	1	1081	183	898
TROOP CARRIER GROUP	C-47	80-110	128	4-5	1837	514	1323
COMBAT CARGO GROUP	C-46 C-47	125	150	4	883	350	533
BECAUSE OF EMPLOYMENT OR VARIATIONS IN GROUP COMPOSITION, THE FOLLOWING ARE BEST DEFINED IN TERMS OF SQUADRON STRENGTH (NORMALLY THREE OR FOUR SQUADRONS WOULD MAKE UP A GROUP)							
NIGHT FIGHTER SQUADRON	P-61 P-70	18	16	2-3	288	50	238
TACTICAL RECONNAISSANCE SQ.	F-6 (P-51) P-39 P-40 L-4 L-5	27	23	1	233	39	194
PHOTO-RECONNAISSANCE SQ	F-5 (P-38)	24	21	1	347	50	297
COMBAT MAPPING SQUADRON	F-7 (B-24) F-9 (B-17)	18	16	9	474	77	397

* AIR COMMANDO GROUPS WERE COMPOSITE UNITS. USUALLY THEY HAD 2 REDUCED-STRENGTH FIGHTER SQUADRONS, 1 TROOP CARRIER SQUADRON, AND 3 LIAISON SQUADRONS.

2/5.

during the war, primarily for purposes of tactical control, but the functionally conceived command, whose development seems to reflect another influence of RAF patterns on AAF organization, came to be the chief agency for coordination of effort between a top air commander and the groups making up his force.† Thus, Headquar-

* Although the group was the yardstick for AAF plans in World War II, more recently wings have been used to describe Air Force goals. The wing plan was adopted in 1947 to unify control at air bases. A modern wing consists of a combat group plus a maintenance-supply group, an air base group, and a medical group. In other words, it is a group plus supporting units operating under the unified command of the wing. Usages have not yet been standardized, however. (See AAF Reg. 20-15, 27 June 1947.)

† In the postwar period the command was put on a higher level. It is now superior to an air force, rather than a subordinate unit as in World War II. Thus in April 1951 the Strategic Air Command had three air forces assigned to it.

ters, AAF depended upon a series of commands in such areas as training, air service, and air materiel to execute its several programs of expansion. For the performance of comprehensive combat missions the practice was to set up distinct air forces comprising such subordinate commands as were considered necessary. Usually, there would be at least a bomber, fighter, and air service command. Numbered more or less in the order of their activation, there were before the end of the war no fewer than sixteen different air forces, four of which were retained in the United States.

It would be a mistake to assume that all air forces or commands

BASIC STAFF DESIGNATIONS, AAF

COMMAND LEVEL	STAFF				SPECIAL STAFF OFFICERS
	PERSONNEL	INTELLIGENCE	OPERATIONS	SUPPLY	
AIR FORCE, COMMAND, OR WING	A-1	A-2	A-3	A-4	**AS REQUIRED**: ADJUTANT GENERAL (OR ADJUTANTS) INSPECTOR GENERAL (OR INSPECTORS) FINANCE OFFICER JUDGE ADVOCATE PROVOST MARSHAL SURGEON STATISTICAL OFFICER WEATHER OFFICER COMMUNICATIONS OFFICER PHOTOGRAPHIC OFFICER CHAPLAIN SPECIAL SERVICES CHEMICAL OFFICER ORDNANCE OFFICER AF ENGINEER (AND OTHERS)
GROUP	S-1	S-2	S-3	S-4	
SQUADRON	ADJUTANT	INTELLIGENCE OFFICER	OPERATIONS OFFICER	SUPPLY AND ENGINEERING OFFICERS	
FLIGHT COMMANDER AIRPLANE COMMANDER	NO FORMAL STAFF REQUIRED				

l.f.s.

conformed to a single pattern. AAF Headquarters exerted some influence on the organization of subordinate agencies, partly by its example and partly through the establishment of basic T/O's for all air force organizations. But few limitations operated to restrict the power of any commander to accomplish his task as he saw fit with the strength assigned to him, and the internal structure of his command might vary greatly in response to a number of factors, including the personality of the commander himself. Following traditional Army usage, headquarters organizations tended to copy the old "S" and "G" staffs, which in the AAF became "A" staff sections. Air forces collaborating with the RAF at times experimented with deputy commanders in lieu of the older chief of staff. The U.S. Strategic Air Forces in Europe, on its establishment in January 1944, tried the so-called "double deputy" type of organization by which staff work was consolidated under two divisions, one for

operations and one for administration.* AAF Headquarters itself acquired a deputy commander before the end of hostilities, a post held by Eaker on his return from the Mediterranean Theater of Operations in 1945. The older idea of directorates, though abandoned in 1943 by AAF Headquarters, continued to enjoy some favor, with a tendency toward adoption of a "three directorate" plan. The directors were not deputy commanders but coordinating division chiefs, who headed staff divisions for operations and training, for personnel and administration, and for supply and maintenance.[52] This plan was tried by the Continental Air Forces when it was established late in the war.

In addition to its own organizations, the AAF depended upon a variety of units which operated, so to speak, on loan from other arms and services. Differing widely in function and size of organization, these units represented the chemical, engineering, finance, medical, police, ordnance, quartermaster, and signal services of the Army. Some of them were specifically organized and trained for duties peculiar to air force needs, as with an engineer aviation battalion or a chemical maintenance company (aviation); some of them, such as the Military Police or representatives of the Finance Department, performed merely the familiar duties rendered all other parts of the Army. Taken in total, they fall under no more specific classification than the rather clumsy official designation of Arms and Services with the AAF (ASWAAF). Their functions were of a kind that caused them to work more closely with the AAF's service organizations than any other, and within the United States the responsibility for their organization and training, insofar as it belonged to the AAF, fell most heavily on the Air Service Command.[53] Their presence, with separate insignia and a continuing obligation to the technical service they represented, served to remind all parties that as yet the AAF, however autonomous it might be, did not have separate status. Their special position, moreover, was related to questions of fundamental importance involving control of activities on domestic airdromes. Beginning in the summer of 1943 the AAF, arguing chiefly the administrative advantages to be gained, undertook to get full integration into the air force of all ASWAAF personnel. The War Department gave its approval in the fall of 1943, but the

* See Vol. II, 753.

changeover had not been completed even at the end of the war.*

The administrative machinery on which the AAF depended for the accomplishment of its primary mission reflected the continuing influence of the air arm's dual organization after 1935. To make the same point in another and perhaps more helpful way, it may be said that the AAF continued to carry within the geographical limits of the United States a double responsibility. While training and equipping combat forces for employment overseas, it was also charged to maintain forces in a state of combat readiness for the immediate defense of U.S. territory. This last responsibility was discharged through the agency of the four continental air forces (the First through the Fourth), which had evolved as elements first of GHQ Air Force and later of the Air Force Combat Command. These air forces, especially the First and Fourth, assumed very heavy defensive responsibilities after the outbreak of hostilities, both for the organization of a modern defense system against the threat of enemy air attack and in attempts to counter the German submarine offensive on the Atlantic coast.† Neither of these obligations, however, so fully absorbed the energies of the domestic air forces as to prevent their continued service, in line with previous practice, as organizations through which the more advanced phases of combat training were accomplished. During the first two years of the war, the latter task fell chiefly upon the Second and Third Air Forces, but all of them carried some responsibility for training, just as each of them was subject to combat duty in the event of an emergency.‡ Meanwhile, the organizations more immediately concerned with the primary phases of training and with problems of equipment and supply followed, in their development, patterns evolving out of earlier usages in the Office, Chief of Air Corps.

Three general patterns of administrative control had developed in the Air Corps: first, a liaison office in Washington serving a division headquarters in the field; second, division headquarters in Washington with field activities as an integral part of the division; and

* At the end of August 1945, ASWAAF personnel represented over 15 per cent of total AAF strength. See below, p. 375.

† Air defense in World War II is discussed below, Chap. 3. The antisubmarine efforts of the AAF may be followed in Vols. I and II.

‡ It may be noted that at the war's beginning Second Air Force held responsibility for the northern part of the Pacific coast, and that the Third Air Force on occasion contributed to antisubmarine patrols.

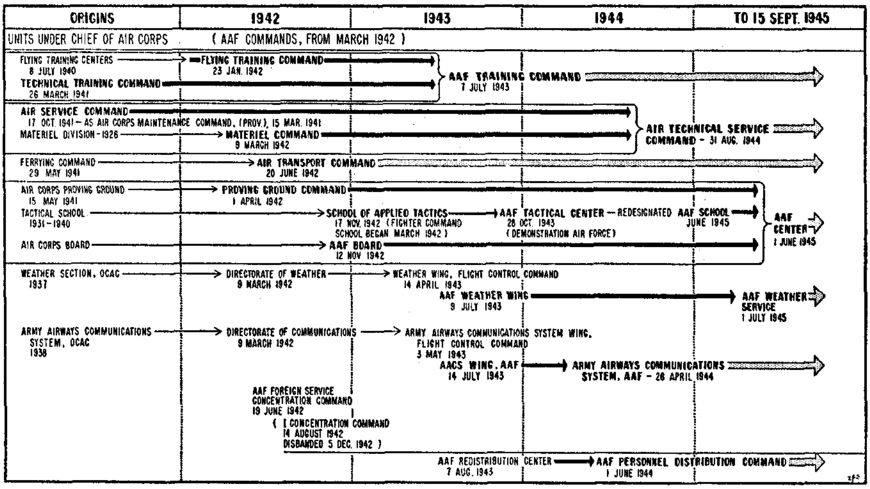
third, a true command relationship with a field headquarters taking orders from the top-level staff in Washington.[54] With the growing need to relieve Washington offices of detailed administration, it was this last system which increasingly dominated the wartime organization. In the effort to achieve decentralization of responsibilities, by January 1942 four commands had been established under OCAC: Technical Training, Ferrying, Air Service, and Flying Training. By mid-1942 the Ferrying Command had become the Air Transport Command, and the Materiel, Proving Ground, I Troop Carrier, and Foreign Service Concentration Commands had been added. At the end of 1942 the headquarters of all commands, except for Air Transport, had been located outside the Washington area.[55] The trend noticeable in 1942 toward the creation of additional commands was thereafter reversed through a policy of consolidating the subordinate headquarters reporting to Washington. From a maximum of fifteen major agencies reporting to AAF Headquarters, the number was reduced to eight by July 1945.

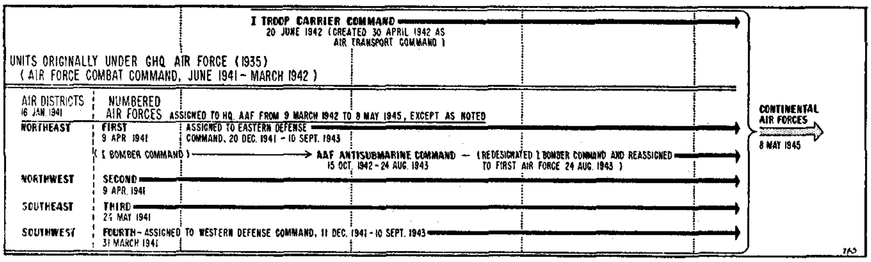
The development of the Training Command, heir to one of the chief Air Corps functions, illustrates the organizational growth of the AAF. In 1939 the training center at Randolph Field ran a "handtailored" program designed to turn out about 300 pilots per year.[56] By July 1940 it had become necessary to divide this work among three regional training centers. The accelerating demands imposed upon these centers is suggested by the following figures: in the 18 years from 1922 to 1940 fewer than 2,900 pilots had been trained by the Air Corps, whereas in the 18 months after July 1941 the graduates numbered more than 29,000.[57] It was becoming clear by the end of that year that closer coordination of the training program would be required and that the responsibility for this coordination would have to be transferred out of Washington. Accordingly, on 23 January the Flying Training Command was organized to supervise the three air training centers, which themselves later became subcommands. Meantime, the need for trained ground crews had prompted the formation, on 26 March 1941, of a Technical Training Command, which in February 1942 expanded its functions by hastily setting up officer candidate schools to relieve the acute shortage of AAF administrative officers.[58] In 1943 the flying and technical training programs were consolidated under the AAF Training Command, established on 7 July with headquarters at Fort

Worth, Texas. Subcommands thereafter included two technical training commands and three regional flying training commands.*

The organization which shouldered the main responsibility for the development of AAF equipment and for the complex services of

AAF COMMANDS AND CONTINENTAL AIR FORCES





maintenance and supply had its origins in OCAC's Materiel Division, which had been set up as a bureau in 1926 with its center at

* Six subordinate commands were established as of 31 July 1943 and assigned to the AAF Training Command: the AAF Eastern Flying Training Command; the AAF Central Flying Training Command; the AAF Western Flying Training Command; the AAF Eastern Technical Training Command; the AAF Central Technical Training Command; and the AAF Western Technical Training Command. The Central Technical Training Command was absorbed into the Eastern Technical Training Command on 1 March 1944.

Wright Field, Ohio. From 1936 to 1939 the Chief of the Air Corps administered the division directly, with the chief of the Supply Division on his own staff as immediate adviser on materiel questions. In 1939 the division recovered bureau status, dividing its own staff between Washington and Wright Field.[59] By 1941 the increasing work load of the division, whose most important function was the development of new equipment, led to a decision to relieve it of responsibility for maintenance and supply services. An Air Corps Maintenance Command established on 15 March 1941 for that purpose became on 17 October the Air Service Command, with headquarters at Patterson Field, Ohio. In the 9 March 1942 reorganization of AAF Headquarters the Materiel Division was reconstituted as the Materiel Command with headquarters at Wright Field. Until August 1944, the Materiel Command remained the AAF's only agency for research and development and for the procurement and modification of equipment. The experimental work of its engineers was centered in an elaborate plant at Wright Field; for procurement the command worked through a system of districts. Modification of aircraft and other equipment was also decentralized, though less systematically. The Air Service Command, as the "stockroom and garage" of the AAF within the United States, attended to the maintenance of aircraft, the distribution of supplies, and the training of service units for the support of combat units. Operating an expanding system of depots, both for repair and storage, ASC worked through area service commands having each a central depot and the necessary subdepots. For technical purposes it maintained connections with air base service agencies within the United States and with the air service commands of overseas forces.*

The separation of materiel functions thus attempted resulted in confusion and no little friction. To overcome this difficulty and to simplify the supervisory responsibilities of AAF Headquarters, General Arnold in 1944 persuaded Lt. Gen. William S. Knudsen to head a unified organization.[60] On 31 August the consolidated field organization emerged under the title Air Technical Service Command.

As an organization which welded civilian and military elements into a truly global airline, the Air Transport Command (ATC) quickly leaped over the geographical limits presumably fixed for

* For discussion of a difficult relationship, see below, pp. 363–68.

activities under the direct command of the AAF.* Before the war was ended, the AAF not only had pioneered the development of air transport in different parts of the globe, but it had explored the possibilities of military air transport far beyond anything undertaken by other nations—and this without the benefit of any serious prewar attention to the problem. The major moves out of which ATC developed date from the spring of 1941. The 50th Transport Wing of the Air Corps Maintenance Command was at that time organized to move technical supplies between air depots and to furnish planes for the training of airborne troops. This marked the beginning of an activity subsequently identified with troop carrier organizations, which in the several combat theaters dropped airborne troops in advance of the main battle lines, executed emergency drops of equipment and supplies to embattled forces in forward areas, and shuttled freight as circumstances dictated. The spring of 1941 saw, too, the activation of the Air Corps Ferrying Command, on 29 May, for aid to the British by flying planes from American aircraft plants to terminals conveniently situated for transfers to the RAF. Before Pearl Harbor this command had assumed added functions: it had begun to deliver AAF planes from factories to domestic bases, initiated a North Atlantic courier route to Scotland, and opened a military air route across the South Atlantic to Egypt. A third development of 1941 had been the government-contract ferrying routes across the South Atlantic pioneered by subsidiaries of Pan American Airways. After Pearl Harbor the Air Service Command expanded its own air transport activity by contract with the civilian lines, and for their administrative control it organized a Contract Air Cargo Division in the spring of 1942.

By that time, as the above facts will suggest, the air transport activities of the AAF were badly in need of coordination. The Air Service Command got out of the business of training troop carriers on 30 April 1942 by transferring its transport wing to a newly created Air Transport Command, but it was soon discovered that this designation was wanted as a new name for the older Ferrying Command, whose functions meanwhile had been expanded beyond the limits implied by its title. Accordingly, on 20 June 1942 the Air

* For the origins of ATC, see Vol. I, Chap. 9. Volume VII will carry the full story. A very readable and authentic story of ATC activity is Oliver La Farge's *The Eagle in the Egg*.

Transport Command came into existence in succession to the Ferrying Command, and the recently created Air Transport Command was redesignated the I Troop Carrier Command. The new command took over the earlier ferrying function, and from ASC it acquired the function and personnel of its Contract Air Cargo Division. More than that, the Army Services of Supply surrendered to the AAF, and thus to ATC, all its interest in air transport. This was a development of far-reaching significance, for it meant that ATC became an agency in which the War Department had centered all responsibility for the development of air transport. With the passage of time, ferrying (i.e., the simple delivery of planes by ferrying crews) became less important in ATC, but air transport, conceived as a strategic service for the delivery of critical items of equipment and supply to combat areas according to an over-all view of their needs, was one of the more significant logistical developments of the war. Through ATC the AAF established its claim to recognition for the distinguished performance of still another independent mission. And ATC operations clarified for more than one theater commander Arnold's status in the high command. After a brief experience had shown that interference by theater commanders with the movement of ATC planes could not be tolerated without sacrificing the whole concept of a strategic air supply, the freight went through on Arnold's orders, except in cases of such extreme emergency that an acceptable explanation could be given to Washington. It took time to iron out all such difficulties, but they were settled and settled in Arnold's favor. With the development of its overseas wings for the direction of ATC operations, the command was by the end of the war deploying a not inconsiderable world-wide force.

The I Troop Carrier Command, which had been so redesignated on 20 June 1942, was destined to serve throughout the war as an agency for specialized training. Responsible directly to AAF Headquarters until it came under the Continental Air Forces in the spring of 1945,[61] it coordinated its activity with the training commands from which it drew its crews, with the four continental air forces which carried the main responsibility for unit training, and with Army Ground Forces agencies for which its training was conducted. The troop carrier crews it produced served in all theaters, where customarily troop carrier groups were under the direct control of a

separate troop carrier command answering to the theater commander through his air commander. The top figure of thirty-two troop carrier groups was reached by the AAF early in 1945.

The AAF Center emerged on 1 June 1945 to coordinate the agencies which formulated AAF standards in materiel and tactics. One of its important units was the Proving Ground Command, which supplemented engineering tests by the Materiel Command with exhaustive technical and tactical studies of aircraft and related equipment, with the purpose of answering two questions: Is this materiel ready for combat? If so, what is the ideal way to use it? The Air Corps Proving Ground had been established on 15 May 1941, and became the Proving Ground Command on 1 April 1942. The main base was at Eglin Field, but its operations used a 600-square-mile area in northwest Florida.[62] Another of the chief elements was the AAF School, a new title given in June 1945 to an old function. There had been an Air Corps Tactical School at Maxwell Field ever since 1931, but this had been suspended in 1940.[63] A step toward its revival came in March 1942 with the establishment at Orlando of a school for the study of special problems in air defense.[64] Drawing heavily on British experience in the Battle of Britain, the school served to formulate tactics and train key personnel in all phases of a modern air defense.* On 17 November 1942, after having been designated as the Interceptor and then the Fighter Command School, the organization became a part of the School of Applied Tactics, which also had departments for bombardment, air support, and air service operations.[65] The school was redesignated the AAF Tactical Center (AAFTAC) on 28 October 1943. Using an 8,000-square-mile area centered at Orlando, AAFTAC served as a sort of postgraduate school for combat unit training and also conducted research in all fields of air warfare. For these purposes it maintained a model task force, which was designated the Demonstration Air Force on 1 November 1943. The AAF Board, which used the proving ground and AAFTAC to conduct detailed tests, was a senior AAF body for the determination of requirements and the formulation of new tactical directives. It had been variously assigned to AAF Headquarters and to AAFTAC, but in June 1945 it became a part of the AAF Center.[66]

Such technical fields as communications, weather, flight control,

* See below, p. 93.

and flying safety presented the AAF especially difficult problems in organization. It had developed an airways communications system before the war for the operation of communications facilities, navigational aids, and control towers at airdromes within the United States. As early as 1940 its facilities began to be extended overseas, eastward across the North Atlantic by way of Newfoundland toward Britain and by way of Brazil to Africa in 1942, and then from Africa to India and China. The extension of these services moved apace with the development of the airways—indeed, were an indispensable preliminary to the development of the airways in any real sense of the term—along which ATC and tactical planes moved in increasing numbers to the combat areas. Given a wing administrative organization in May 1943, the communications system grew from a personnel strength of 2,100 in 1941 to 32,700 in 1944.[67] The AAF Weather Service had greatly expanded its facilities in 1941 in response especially to the need for exact reporting of weather conditions affecting the North Atlantic air route to Britain.* With stations located in Greenland, Newfoundland, Labrador, and other points, the service in time provided continuous and comprehensive weather data for the northern hemisphere. Its services having been further extended, and meteorologists having been trained in large numbers for AAF assignments, the weathermen in many different parts of the world became an important source of the intelligence which guided the planning and execution of combat missions.†

In the first plans for the reorganization of March 1942, separate commands for weather and communications were projected,[68] but these responsibilities went instead to the directorates of Weather and of Communications, both subsidiaries of the Directorate of Technical Services. On 29 March 1943 the Flight Control Command was activated, and in the following two months it was given control of the Weather Wing and of the Army Airways Communications System Wing, together with many of the functions of the Directorate of Flying Safety and some of the duties of the Directorate of Civil Airways. This setup lasted, however, only a short time. In July 1943 the Weather Wing was redesignated the Army Air

* See Vol. I, 344–46.

† See, for example, the influence of weather reports on the dramatic development of the "Big Week" of strategic bombing over Europe in February 1944, as presented in Vol. III, 30 ff.

Forces Weather Wing and, along with AACS Wing, was assigned to AAF Headquarters, under the immediate supervision of AC/AS, OC&R. On 1 October the Flight Control Command was abolished and its successor, the Office of Flying Safety, was established at Winston-Salem, North Carolina, in the facilities of the old Directorate of Flying Safety.[69] The AACS Wing operated under AC/AS, OC&R until April 1944, when it received command status as the Army Airways Communications System, with headquarters at Asheville, North Carolina. The AAF Weather Wing and the AAF Weather Service were put under the supervision of an Air Weather Officer in AC/AS, OC&R on 10 July 1943; on 2 September of the same year the Weather Division, responsible for operation of the AAF Weather Service, was created in AC/AS, OC&R. On 1 July 1945 the Weather Division was abolished and the AAF Weather Wing, having become the official weather agency of all components of the Army,[70] was given command status under the name of the AAF Weather Service.[71]

The handling of large numbers of troops en route to combat or returning for reassignment posed special problems in organization. The first phase, that of final preparation for unit movements overseas, was briefly entrusted to the Foreign Service Concentration Command, which was activated on 1 July 1942 and redesignated on 14 August as the I Concentration Command. Since this proved to be a complicating element in the chain of command, on 5 December 1942 the command was disbanded and its functions given to the four domestic air forces and the Air Transport Command.[72] In 1943 the AAF met a new personnel problem, to which it applied an original solution: to interview, rehabilitate, and reassign men returning from overseas, an AAF Redistribution Center was established on 7 August 1943, and given command status on 1 June 1944 as the AAF Personnel Distribution Command.[73] This organization was ordered discontinued, effective 30 June 1946.

The Numbered Air Forces

As has been indicated in the preceding chapter,* the four continental air forces owed their origins to an order of 26 March 1941.[74] The three wings through which GHQ Air Force controlled its bomber and pursuit units had proved ill-adapted to the requirements

* See above, p. 21.

of the major expansion undertaken in 1940, and on 16 January 1941 the four air districts—Northeast, Northwest, Southeast, and Southwest—had been activated. Two months later the four air forces were activated pursuant to new plans for continental defense which assigned the responsibility for air defense to the GHQ Air Force.* The location of the new forces coincided approximately with the former air districts. The First Air Force, with headquarters at Mitchel Field in New York, deployed its units in the northeastern part of the country. Defense of the southeast was the province of the Third Air Force with headquarters at Tampa in Florida. Second Air Force located its headquarters at Fort George Wright near Spokane, Washington, in accordance with its responsibilities for the northwestern area. The Fourth Air Force at Riverside, California, took charge in the southwest, receiving eventually responsibility for the entire Pacific coast by a rearrangement with the Second Air Force after Pearl Harbor.

During 1941 the internal organization of the four air forces reflected the growing influence of military developments in Europe. The major structural change came in the substitution of subordinate functional commands for the older wings. A directive of 12 April 1941 ordered each air force to organize a bomber and an interceptor command, in order to "create offensive and defensive task forces larger than single wings."[75] The bomber commands, conceived as air striking forces, were embodiments of the Mitchell tradition of offensive air power. The creation of the interceptor commands bespoke a new sense of the urgency of air defense as a result of the Battle of Britain, and to them went the responsibility for creating an aircraft warning system in addition to their primary function of air interception. If the interceptor commands owed their origins largely to the magnificent example provided by RAF Fighter Command in the Battle of Britain, the skillful work of the Luftwaffe in the Battle of France had much to do with the establishment of new air support commands in the summer of 1941. It had been well understood on the organization of the GHQ Air Force in 1935 that in the event of a successful amphibious assault against the United States all air elements would concentrate, in close collaboration with defending ground forces, on the expulsion of the invader, but the stress had been placed on the role of air striking forces in repelling

* See below, p. 86.

a threatened invasion. It was also understood that War Department policy then and for some time thereafter viewed air support of ground operations as the primary mission of the Air Corps, and the wing organization, which embraced under one head interceptor and bomber forces, was adaptable enough to that need. But observation and reconnaissance aircraft, whose functions were closely related to ground force needs, continued to be classed as "corps aviation" and were not assigned to GHQ Air Force. The five air support commands—one for each of the air forces and a fifth to work with the Armored Force—created under a War Department order of 25 July 1941 were to include reconnaissance, observation, and bomber types especially suited to the immediate support of ground operations.[76] To the bomber, interceptor, and air support commands the AAF added air base commands in October 1941.[77] These base commands were intended to free air force commanders of administrative details relating to service and supply activities—they were, in short, forerunners of the later air service commands.

All planning in 1941 rested upon the assumption that the major theaters of combat would lie outside U.S. territory. Accordingly, each air force and each command—whether bomber, interceptor, air support, or base—was instructed to divide its forces between mobile elements capable of operating at once in any area and stationary elements ready to take full responsibility within the original area assigned.[78] In other words, the air forces were given a double duty: to stand guard in given areas against the threat of enemy attack and to be ready, without lowering that guard, to provide expeditionary forces. These plans gave no exact forecast of practices later followed, but the continental air forces did serve as the principal channels through which organized units were brought to a state of combat readiness for transfer to overseas duty. Not only did they contribute to the reinforcements forwarded to outlying stations on the eve of Pearl Harbor, but they provided cadres and units for new combat air forces thereafter.*

The major responsibilities of the continental air forces during the war years were air defense and training. Theaters of operations having been promptly activated on the two coasts, the First Air Force was assigned to the Eastern Defense Command and the Fourth Air Force to the Western Defense Command. This left the Second and

* See Vol. I, 612–14, on the origins of the Eighth Air Force.

Third Air Forces to the AAF for concentration primarily on unit training, an activity directly supervised by AAF Headquarters after the inactivation of AFCC in March 1942. Differences in function, both among the several forces and by contrast with prewar assumptions, brought changes of internal structure. The base commands in all four air forces were quickly inactivated under authority granted by the War Department early in May 1942.[79] They had served chiefly to complicate command channels, and it seemed best to concentrate responsibility for air service within the Zone of Interior in the rapidly developing agencies of the Air Service Command. The first months of the war produced no need for the air support commands, except as an experimental type of organization for test and development of air support tactics. By the summer of 1942 only the Third Air Force's support command remained. That organization, successively designated III Ground-Air Support Command (24 May 1942), III Air Support Command (19 September 1942), and III Reconnaissance Command (18 August 1943), became the III Tactical Air Command on 10 April 1944.[80] The original concept of an air support command, embracing fighter and bomber types best suited to ground support, received its chief test in the Mediterranean theater. The experience there served to affect both doctrine and organization in the invasion of western Europe, where the ubiquitous fighter-bomber became the chief dependence in supporting operations directed by several tactical air commands. Elsewhere, as in the Fifth Air Force, a simple division of forces between bomber and fighter commands proved to be a more flexible and therefore more useful arrangement.

The Second Air Force, which had no active defense role to play, lost its interceptor command early in the war to the regrouping Southwest Pacific air forces, which became the Fifth Air Force. Its bomber command was retained as a reserve unit for emergency reinforcement of other air forces.[81] The First and Fourth Air Forces depended for the performance of their defensive missions chiefly upon interceptors, a designation abandoned by the AAF in May 1942 in favor of the term "fighter."[82] A special role was reserved for the I Bomber Command, which began antisubmarine operations along the east coast on 8 December 1941. Operational control of the command passed to Eastern Sea Frontier on 26 March 1942; on 15 October of that year the command's units were assigned to the AAF

Antisubmarine Command, whose complicated existence has been treated in detail in earlier volumes.* The Antisubmarine Command endured until 24 August 1943, at which time its remaining units were assigned to the reactivated I Bomber Command.[83]

From Pearl Harbor to September 1943 the domestic air forces had to straddle two conflicting missions. Air defense operations, which monopolized the energies of the First and Fourth Air Forces, required maintenance of strong fighter forces plus an organization for supervision of the air warning machinery.† The Second and Third Air Forces, by contrast, concentrated on training, with the emphasis falling originally on the operational training unit (OTU) programs through which graduates of the training schools were welded into combat units. No complete specialization by air force was attempted, but the Second Air Force emphasized heavy bombardment unit training, while the Third Air Force stressed fighter aviation and light and medium bombardment, as has been suggested by reference to the survival of its air support command. The training programs having proved too heavy to handle without use of the experienced pilots assigned to the First and Fourth Air Forces, directives of May and June 1942 brought these two commands into a more active participation in the OTU programs.[84] As this necessity indicates, the heaviest burden carried by the domestic air forces was that of training. Statistics on the relative strength of the air forces in September 1943 emphasize the point:[85]

		Personnel	*Combat Aircraft*
Primary Mission–Defense	First Air Force	73,300	701
	Fourth Air Force	74,400	497
Primary Mission–Training	Second Air Force	186,600	1,389
	Third Air Force	155,100	2,009

The training air forces, it will be noted, were more than twice the size—in both men and planes—of the defense air forces. On 10 September 1943 the AAF recovered complete control of the First and Fourth Air Forces with their release from the defense command assignments.[86] Thereafter, training became the main assignment of all four air forces.

By late February 1944 approximately 90 per cent of the units planned for the AAF had been activated, and nearly three-fourths

* Vol. I, Chap. 15, and Vol. II, Chap. 12.

† See below, pp. 86 ff.

of the existing units had been dispatched to combat theaters.[87] The training of individual "filler" personnel under a replacement training unit (RTU) program became now, except for such special programs as that for B-29 organizations, more important than unit training. Standard military units, based on relatively inflexible tables of organization, were proving less well adapted to the new work than to the old.[88] Accordingly, a more functional system was outlined in an AAF directive of 23 February 1944, which ordered the reorganization of all continental air force installations as AAF base units.[89] Each base, and each higher command echelon, was given a separate designation by number. These changes were accompanied by widespread experimentation with a three-directorate system of administration, through which staff responsibilities were grouped under directors of administration, operations, and materiel. The directors normally absorbed both the traditional general staff sections and the special staffs. Despite some resistance, the experiment was destined to leave its mark on postwar organization of the U.S. Air Force.[90] The changes did not affect all commands at the same time, nor to the same degree. The Fourth Air Force, for example, applied the new directive on 1 April 1944, accompanying the change with inactivation of both the IV Fighter and IV Bomber Commands.[91] By contrast, the First Air Force did not complete the change-over until 15 June, and retained both I Fighter and I Bomber Commands.[92]

In order to reduce the number of commands reporting to AAF Headquarters, Continental Air Forces was established late in the war to coordinate the work of the four domestic air forces and of the I Troop Carrier Command. CAF missions included supervision of the air defense of the United States, of joint air-ground training, of redeployment after the defeat of Germany, and the formation of a strategic air reserve. Although it was activated on 15 December 1944, CAF did not assume jurisdiction over its subordinate commands until 8 May 1945, and did not become fully operational until 1 June, by which time redeployment had become its major task.[93] With the introduction of CAF, the organization of AAF forces within the United States had come full circle, for the new command bore a close resemblance to what the Air Force Combat Command might have become if circumstances had permitted its retention—under a new title and a redefined mission—as an echelon between AAF Headquarters and its subordinate air forces.

Summary and Prospect: The United States Air Force

The wartime structure of the AAF—and of the entire national military establishment, for that matter—was a bundle of compromises. Skeptics might even be tempted to say that combat success came in spite of a clumsy organization, but this would be merely to emphasize the national potential for war. Whatever the faults of organization, there were hidden resources which did not show on organization charts: among others, the vast industrial power of the American economy, technical and scientific skills which proved versatile in new fields, the managerial skill which helped mold inexperienced civilians into a potent military force, and the capacity of military and civilian elements of the population to work in partnership.

At the highest level of the military command, the Joint Chiefs of Staff made "government by committee" work better than anyone had the right to expect. There were difficulties, especially noticeable in the earlier part of the war, but an improved machinery, reflecting a growing awareness of the necessity in a coalition war to reach decisions through joint procedures, paid off handsomely in the end. If there was a major fault in the organization of the national war effort, it is to be found not in the provisions for the formulation of military strategy but in the failure to achieve a better integration of military policy with other national policies. That the new role of aviation in modern warfare received recognition by those charged with the ultimate formulation of strategy is indicated by the many advantages the AAF gained through its active participation in the work of the JCS. Within the War Department, leaders displayed an unusual capacity for working out effective compromises which retained the advantages of a traditional association of the AAF with the Army while not denying to the former expanding opportunities for independent development. By the end of the war the establishment of a separate air force had become a virtual certainty, and in the shift to its new status as a separate service the Air Force enjoyed many positive advantages from the autonomy it had long experienced.

That autonomy had given into the AAF's own hands, in large part, the right to determine its own internal structure. Its efforts to achieve the most efficient organization had to be experimental. There were mistakes and more than one occasion for reconsideration, as organizations were created, subdivided, recombined, or inactivated in rapid

order. But there are larger patterns: in the early stages new commands were established to give close attention to each phase of the rapidly expanding air program; after mid-1943, as the build-up gathered momentum, it proved possible to simplify the structure. The experience of the war years argued strongly for a functional type of organization as free as possible from the type of geographical limitation that had seriously interfered with the training missions of air forces assigned to regional defense commands. The lesson was not without its effect on the postwar reliance upon a series of commands—Air Defense, Strategic, and Tactical—which were based on functional specialization rather than on territorial assignments.[94]

About one problem in organization—the need for a unified Department of Defense—the lessons of the war proved conclusive. There was general recognition that in modern war, with its incredibly costly technical equipment, the United States, despite all its resources, could no longer afford to neglect the opportunities for a closer coordination of its military programs. The National Security Act of 1947, creating the United States Air Force as an equal partner of the Army and the Navy, placed all three of the services under a new Department of Defense. This act did not, in itself, guarantee unified action, but it provided the machinery through which a more effective application of the nation's power might be achieved.

CHAPTER 3

* * * * * * * * * * *

AIR DEFENSE OF THE UNITED STATES

DURING the Second World War the people of the United States faced for the first time the problem of organizing an effective defense against the threat of air attack upon the North American continent. Accustomed to depend upon the protective expanse of two broad oceans but shocked by the fall of France and the Battle of Britain into a new awareness of the rapidly developing potential of air weapons, the American public found itself divided, even on the fundamental question of the need for an air defense. In the days before Pearl Harbor many no doubt agreed with the sentiment expressed on 14 October 1941 by the New York *Daily News* that "a lot of the present Civilian Defense excitement is propaganda, stirred up for the purpose of making people want to fight Hitler."[1] Those who rejected that assumption could still question the possibility that within any immediate period an enemy of the United States would be in position, with the necessary equipment, to launch a successful air attack upon this country. Nor did the resulting apathy go without some justification in both the words and actions of government. The trend of public policy, from the destroyer-base deal with Britain in 1940 through the Lend-Lease Act of 1941, focused attention chiefly on the prospect that the potential enemy in Europe might be denied an opportunity to get within reach of the United States—a policy in accord with the favored doctrine among airmen that purely defensive measures constituted no real defense against air attack. As for the Japanese threat on the Pacific side, few seem to have doubted that the U.S. Navy would be equal to any challenge made. On 22 October 1941 Artemus Gates, Assistant Secretary of the Navy for Air, assured the public that "with

the Navy patrolling the Pacific, and with coastal defense and Army facilities taken into consideration, it is hardly conceivable that West Coast cities could be bombed."[2]

If public indifference retarded the effort begun midway in 1941 to organize an air defense, the Pearl Harbor attack at the close of that year produced a quite different and potentially dangerous mood. Suffering from the chill which comes with a sense of sudden exposure, the public, and especially that part residing in coastal cities, pressed upon the government a need for adequate defense of the "more vital areas." It would be unfair to the American people to suggest that general indifference gave way to general hysteria.* But Pearl Harbor emphasized the risk of carrier-borne air attack, a risk heightened by the loss of defensive naval forces. The President himself pointed the moral when he bluntly warned the nation by radio on 9 December 1941 that the initial attack could be repeated along our own coast lines. In the circumstances, the message probably carried a greater impact on the west coast than on the east, but German submarines were soon operating close enough to our eastern seaboard to underscore the President's proposition that we no longer could "measure our safety in terms of miles on any map."[3] No air attacks materialized, and within three months the government faced the necessity to combat, with the aid of the press, a dangerous popular illusion as to the possibilities for air defense and as to the relative claims of the home front and the combat zones.[4]

It may be that the government provided more defense against air attack than was needed in the period extending from 1941 into 1943. Certainly there was no enemy air attack to justify the expenditure of energy, time, and funds devoted to air defense through these years. Certainly, too, the decision to cut back the expenditure on air defense in 1943 was justified by experience which supported the airman's proposition that the best defense was to take the offensive—that is, to force the enemy to concentrate his resources upon defensive measures. And yet, at the very moment when offensive air power was raining destruction on the cities of Germany and Japan, the Japanese struck back with the only air offensive sustained by this nation to date. The results of that offensive—dependent as it was upon free balloons—were insignificant, but the question it poses in an age of atomic weapons is of the first importance.

* See Vol. I, 272 ff. for discussion of the early period of alerts and alarms.

Of one point the historian can be certain and that is this: that some review of the nation's experience in World War II has, under existing conditions of international affairs and the current state of aeronautical technology, an unmistakable timeliness.

The Prewar Problem

The general state of unreadiness in which the nation was caught in 1941 is not difficult to explain. After World War I the American reading public had been exposed to a barrage of sensational accounts predicting that future wars would begin with aerial assaults against national heartlands. Typical was an article in the *New York Times* of 18 April 1920 which foresaw that entire industrial areas would be pulverized, with heavy losses among the civilian population. "The campaign would be brief," the writer concluded, "and the chief sufferers would be, not the soldiers and sailors of the weaker nation, but the inhabitants of cities."[5] There was truth enough in this prediction, but it obviously had no immediate application to the United States in the age of the biplane. And those whose thinking ran ahead to comprehend the destructive power of future airplanes—who, of course, were chiefly the airmen—were not themselves primarily interested in the problem of defense.

Billy Mitchell and his cohorts in the Air Service repeatedly showed a sensitive regard for the national mood by presenting the case for heavier emphasis on aviation under the guise of a "Winged Defense," But the Mitchell legacy to the Air Corps stressed the need for offensive striking power as the only true air defense; "to sit down on one's territory and wait for the other fellow to come," Mitchell wrote in 1925, "is to be whipped before an operation has commenced."[6] The attack had to be carried to the enemy, to destroy his air bases, his planes, and the industrial installations upon which his capacity to wage war depended. Mitchell wrote before radar had provided the means for advanced warning of attack and for the guidance of intercepting planes or ground antiaircraft fire. Effective interception, in his view, had to depend chiefly upon luck, and the "idea of being able to defend any locality with anti-aircraft guns, cannon or any other arrangement from the ground [was] absolutely incapable of accomplishment."[7] Money spent on purely defensive measures would be thrown away, with no result other than to encourage a false sense of security.[8]

By the early 1930's the Air Corps had come to pin its chief hopes for winning a clear-cut mission of its own in the general area of coastal defense. Following the MacArthur-Pratt agreement of 1931, which seemed to open the way for assumption by Army air of a major responsibility for coastal defense,* the Air Corps gave its attention to the organization and equipment that would be needed to offset an assumed vulnerability to carrier-borne air attack.[9] By 1933 the Air Corps had ready ambitious plans for aerial patrols reaching 300 miles to sea and for a long-range bomber that would greatly extend the reach of a shore-based striking force. But the Baker Board in 1934 reaffirmed the old faith in ocean barriers guarded by sea power, and the Navy subsequently showed hostility to all efforts by the Army to develop an overwater reconnaissance mission. Only the long-range bomber and the GHQ Air Force materialized from the hopes of 1931–34, and both of these tended to place the emphasis on the offensive, rather than defensive, employment of air power. Brig. Gen. Henry H. Arnold summed up the Air Corps' point of view in 1935, the year which brought the GHQ Air Force into existence, when he declared to a group of visiting congressmen at headquarters of the 1st Wing: "Our whole concept in the Air Force is offense: to seek out the enemy; to locate him as early and as far distant from our vital areas as we can; then to carry the fight to him and keep it there."[10]

It cannot be said that a more generous recognition of the role of land-based aviation in coastal defense would have altered the Air Corps' basic approach to the problem of air defense. It can only be noted that the Air Corps already had, in its long-established function of interception, a vital part to play in the active defense of land targets, and that acceptance of the proposed reconnaissance mission would have represented an enlargement of Air Corps responsibilities in an area of activity as pertinent to the passive as to the active defense of those targets.

Passive measures of defense (i.e., those taken to minimize the damage on the ground resulting from air attack) depend for full effectiveness, as do the active efforts of intercepting planes and antiaircraft guns, first of all upon a warning of the impending attack. Plans drafted in 1935 by the Army for an aircraft warning service depended wholly upon recruiting civilian volunteers to serve as ob-

* See above, p. 5.

servers along anticipated lines of approach to vital targets. Proposals for seaward patrol by Air Corps planes having been rejected (and it would have been expensive to implement them), there was no provision for early warning of planes approaching from the sea.[11] An Air Corps study in 1936 considered the creation of any early warning net of observers an impossibility and doubted if public apathy could be sufficiently overcome to render effective any effort to create a landward net in time of peace—conclusions reached with reluctance in view of the vital importance of a warning service to the initial usefulness of interceptors.[12] Tests in 1937 of proposals by a California utility company that a warning net be built on the communications facilities of utility concerns proved disappointing.[13] In October 1938 a major test in North Carolina reinforced the War Department in its earlier conviction that civilian observers reporting over commercial telephone lines offered the best prospect for a workable warning service.[14] It was assumed that such a service would have to be, and could be, established on short notice.[15]

In 1938, as war clouds thickened over Europe, Louis Johnson, Assistant Secretary of War, undertook to stimulate new interest in air defense. Pointing to the experience of China and Spain, he felt that thoughtful Americans should "stand aghast at a contemplation of the havoc which a hostile bombing attack could and, in the event of war, doubtless would wreak on our unprotected cities."[16] His ideas failed to prevail, however, in a War Department increasingly concerned with the manifold problems of a major expansion of the military services. Testifying before Congress in February 1939, General Marshall discouraged demands for guns to defend major U.S. cities because of the over-all burden that had to be placed upon existing industrial capacity.[17] As late as May 1940 the Chief of Staff told congressmen that "what is necessary for the defense of London is not necessary for the defense of New York, Boston, or Washington." Although he admitted that American cities could be raided, Marshall contended that continuous attack was impossible until an enemy had bases close to North America.[18]

Although this conclusion was fully justified by subsequent experience, it helps nonetheless to explain how it was that the United States lagged behind other countries, and notably Britain, in the development of technical aids which revolutionized the older concepts of air defense. The chief of these aids was radar—a device which could be

used to deprive attacking air forces of the tremendous advantage of surprise.

Since the First World War every major nation had sought a reliable detector of hostile aircraft, but early efforts—usually aimed at some effective audio device—proved unrewarding. The answer to the problem was to be found as a result of experiments in pure science, not military research. In an effort to measure the height of the layer of ionized air which reflects radio waves back to the earth, American scientists in 1925 sent out very short pulses of radio energy and timed the "echo."[19] Experts in many nations quickly realized the possible application to the problem of detecting planes, and after the rise of Hitler a secret international race to develop radar began. In the United States the Army and Navy followed their own separate programs. The first congressional funds went to the Navy in 1935, and within four years a practical set for ships at sea was under test. The Army designed a radar device to control the fire of antiaircraft artillery, SCR (Signal Corps Radio)-268, and was able to give preliminary tests in May 1937 before an audience that included congressmen and War Department officials. General Arnold, greatly impressed by this demonstration, urged that the Signal Corps enlarge its radar program to include development of a long-range set which could provide early warning for air defense forces.[20] By 1939 a prototype of SCR-270, a mobile set with a range of over 120 miles, and its fixed-installation companion, SCR-271, were ready for tests. But not until 1940 were operational models available for use, the first being installed that year for defense of the Panama Canal.[21] A key officer later explained that the Army "simply did not have the funds or manpower . . . to fool with it."[22]

One suspects, however, that a much more fundamental explanation was simply the absence through prewar years of any urgent sense of need for such a device. In contrast, the British, living close to their potential enemies, had pressed their radar program with exceptional vigor since 1934. Within a year of that date a warning net using wave lengths of ten meters—the first operational system in the world—was in use; by 1939 a continuous chain of stations guarded the coasts. And then midway in 1940, British scientists developed the resonant cavity magnetron, "a radically new and immensely powerful device" which made microwave radar a practical reality.[23] Employing wave lengths of ten centimeters, the new microwave sets gave greater range and an

amazingly increased capacity to distinguish between targets which were close together.[24] Moreover, the new sets were less subject to interference, or "jamming," and had the distinct advantage—especially important for airborne use—of being lighter in weight. The device not only greatly strengthened ground warning nets but promised the effective employment of radar by intercepting planes against night attacks. The British were also pioneers in the development of another tool of vital significance for air defense, very high frequency (VHF) radio for ground-to-air and plane-to-plane communication. Incomparably superior to the high frequency (HF) sets standard in the U.S. services, VHF radio offered great assistance in the control and direction of interceptor forces.

Fortunately, the British government was very prompt in making its findings available to the United States. The first magnetron—"the most important item in reverse Lease-Lend"—reached this country in August 1940.[25] By agreement between the two countries a new radiation laboratory at MIT undertook the development especially of airborne microwave sets, which had a military value extending far beyond the area of air defense. A radically improved airborne radar (SCR-520) was under test by March 1941, with production scheduled for 1942.[26] SCR-522, though not available in quantity until the fall of 1942, was adopted in August 1941 under a plan for rapid conversion of the AAF to VHF radio.[27]

The revolutionary potential of these devices added new stimulus to a growing concern within the Air Corps for its air defense responsibilities. Even though effective attack upon U.S. cities might still seem a remote possibility, it was becoming increasingly clear that that possibility was less remote that it had been. Moreover, the problem of air defense involved important considerations for the security of outlying bases and of armies and air forces engaged in field operations. In November 1939, two months after the war had begun in Europe, Arnold admitted to Marshall that the tactics of defensive aviation in this country had been allowed to lag seriously. As a corrective, he proposed the establishment of a new command to study both doctrine and equipment.[28]

The Beginnings of an Air Defense Net

The War Department responded to Arnold's proposal by activating the Air Defense Command on 26 February 1940 under the command of Brig. Gen. James E. Chaney. The new organization consisted of

a small headquarters planning staff, with never more than ten officers assigned, and a permanently assigned signal service. Working in the area of the First Army, the command was directed to explore methods of defense for cities, bases, armies, and industrial areas. In other words, it was charged to study the whole problem of air defense. In actual tests to be undertaken, General Chaney would have control not only of interceptor planes but of antiaircraft guns and warning services.[29]

The first major assignment of the new command was the operation of an air defense net in connection with First Army's 1940 maneuvers near Watertown, Connecticut. The maneuvers, extending from 19 to 23 August, marked a new stage in defense experiments; for the first time pursuit planes, antiaircraft artillery, and a warning service operated under one commander to defend an American army in the field. The great value of a coordinated defense was indicated by official estimates that sixteen times as many planes would have been required if no warning net had been available. Two radar sets, used experimentally in the exercise, proved their value, but the obsolescent HF radio was of sharply limited utility.[30] Following the Watertown war games, Chaney was sent to England for study of the RAF tactics of defense just as the Battle of Britain mounted toward a decisive climax. His report of 15 December 1940 emphasized the advantages in the British system of effective teamwork by fighter planes and warning services, advantages gained through centralized control by the air force commander of all air defense agencies.[31]

The first full-scale test of the air defenses of a vital urban area of the United States was carried out by the Air Defense Command in January 1941. The warning service, easily the most elaborate yet attempted in America, was organized in a sector reaching along the east coast from New York to Boston, with more than 10,000 volunteer observers at 700 posts and with seaward warning provided by radar. Twenty-eight test raids were completed in the period 21–24 January. The results convinced the Air Corps that control of interception from regional centers was practical, provided better radio equipment could be secured. Although the work of the ground observers was disappointing, the volunteers at the information centers gave excellent performances.[32] Before the lessons of the January exercise could be fully appraised, the responsibilities of the Air Defense Command passed to four newly created interceptor commands, which were obligated under a new pattern of defense to provide a full-fledged guard for the air frontiers of the nation. But the Air Defense Com-

mand, which from the first had been intended to do no more than provide experimental evidence on the problems of air defense, had already accomplished its main purpose. Its studies confirmed the conviction in the Air Corps that full responsibility for air defense should be concentrated under one command, and that an air command. Its experience was passed along to sixty-three key officers of the new interceptor commands at a three-week indoctrination course beginning on 25 March 1941 at Mitchel Field, Long Island.[33]

The defensive organization which took shape in the spring of 1941 represented a major victory for the Air Corps point of view. In May 1940 the commanders of the four field armies had been assigned responsibility for establishing an aircraft warning service.[34] Throughout the following winter, airmen, who had been greatly impressed by the advantages of the British system, feared that an opposing opinion supported by WPD might prevail.* In February 1941, however, Marshall decided that air defense should be a responsibility of the GHQ Air Force, soon to be redesignated the Air Force Combat Command.[35] That organization, it will be recalled, controlled the four continental air forces, each of which had jurisdiction over an area roughly corresponding to one of the four new defense commands–Northeastern, Central, Southern, and Western. Each air force was to create its own interceptor command with immediate charge of air defense agencies in its area, including aircraft warning services and antiaircraft units. Passive defense of urban areas remained the concern of locally organized civilian units which were coordinated after 20 May 1941 by the Office of Civilian Defense.[36]

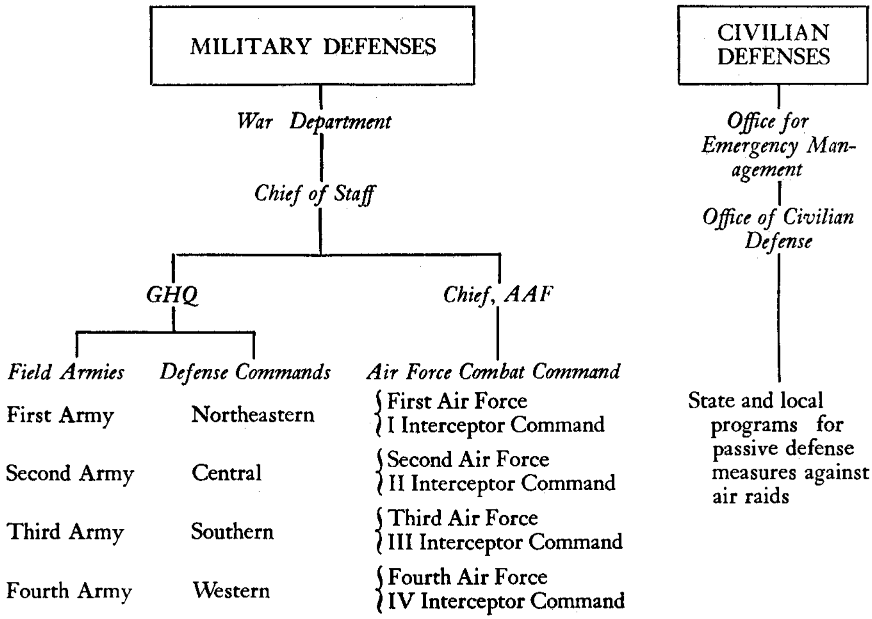
This reorganization left some questions unanswered, among them the question of just who in the event of war would be in actual command of air defenses in any given area. The air units had commitments to other Army organizations charged with defense against enemy attacks, and the interceptor commands would find repeated necessity in the fulfillment of their own special responsibility to coordinate with the field armies and the defense commands. Should air attacks be made as part merely of a general amphibious assault, it could be anticipated that unity of command over all forces would be sought through the establishment of an appropriate theater of operations under some Army or Navy commander. But in the event the

* For fuller discussion in connection with related questions of organization, see above, pp. 21–22.

country was directly attacked only by air, who then would command the defense? This was a question intimately joined to the whole issue of the AAF's relation to the Army, and like other such questions was left for time to solve. It was clear enough, however, that for the time being the interceptor commands had the job of preparing for air defense and that they would be guided in its development by policies shaped in AAF Headquarters.*

As plans took shape in the spring of 1941, the responsible agencies operated under a deadline calling for readiness by 1 August—a very short interval in which to accomplish the ambitious objective set. Along both coasts a series of radar stations (then called "derax") had to be located and their equipment installed for early warning of an enemy's approach by sea. Volunteer observers had to be recruited, organized, and trained by the thousands for tracking the movement of planes over land. Information centers to receive and filter the reports from radar and observation posts had to be provided, with facilities equal also to the needs of an air force controller who would issue the necessary orders to alert all defense agencies, both passive and active. There is no cause for wonder that the job was not completed on schedule.

* The following simplified scheme of organization for over-all defense in 1941, leaving out the Navy, suggests the parallel responsibilities of the several agencies:



In the beginning there was delay even in the establishment of the new interceptor commands; one of the headquarters, in fact, was not activated until 14 July.[37] In all cases, the effort to round out a necessary organization ran into the common difficulty besetting the Air Corps at that time—the shortage of qualified personnel. Since the first problem was one of organization, the critical 1941 shortage of fighter planes was of less immediate importance. But the shortage persisted with resulting delays in necessary training programs; at the beginning of December 1941, for example, I Interceptor Command on the east coast had only 54 planes ready for action and 227 pilots.[38] The command could assign planes to the defense only of Boston and New York, leaving other regions unprotected. In California, when the war came, IV Interceptor Command had sixteen modern fighter planes in combat readiness.[39] The explanation is a simple one: the whole AAF could muster no more than 969 modern fighter planes at that time,[40] and there were many commitments.

Similarly, the antiaircraft (AA) units, trained and administered by the Coast Artillery but assigned to the interceptor commands for operational control in 1941, were too few and their equipment too scarce. There were so many vital installations in relation to available AA strength that dispositions had to be based on a system of priorities—which meant in reality that responsible officers did the best they could to guess where attacks were most likely to be made. Typical of the gulf between needs and resources was the situation in southern California. The first plans of 1941 were so ambitious as to be dubbed, later, the "Santa Claus Plans." By late August 1941 a moderate schedule to cover immediate emergencies had been framed. This minimum plan called for 120 three-inch guns for Los Angeles and its immediate environs, but in December there were only 12 guns on hand to protect all the defense plants of that area. For San Diego the Army had no mobile AA strength at all to assign. The planners related later that they had done everything they could for San Diego—they had prayed that no attack would come.[41]

Fortunately, state councils of the Office of Civilian Defense could assume the main responsibility for recruiting volunteer ground observers.[42] But these councils required assistance and guidance from the interceptor commands in the location and establishment of necessary air defense regions. In delimiting these regions the planners employed new maps based on the boundaries of telephone service areas.

A reporting post for each thirty-six square miles was the normal minimum requirement.[43] In theory, the volunteers were to be trained by the interceptor commands, but military staffs were so limited that they did well to get instructions by mail to the chief observer in each area.[44] Except for the New York and Boston regions, there usually existed no previous experience or organization on which to build a ground observer unit. More serious was a general public apathy about the need for such an organization. Not until war came would there be a marked change.

The radar stations, to be manned exclusively by military units, required large numbers of trained technicians and the installation of complex equipment. More immediately, the choice of locations proved to be a time-consuming project in itself. In selecting radar sites, the first task was to formulate a general strategic plan for coverage of exposed areas; with this plan to guide them, special boards then chose tentative locations. For each radar two plots of land, each 300 feet square, were needed. Once the War Department had approved the site, the District Engineer acquired the property, temporarily by right of trespass and permanently by lease. If tests with mobile radar equipment gave promising results, permanent construction began, with the Chief of Engineers in charge of plant construction and the Chief Signal Officer responsible for installation of technical equipment.[45] These complicated procedures, necessary by law, made swift action extremely difficult. The goal was a chain of radar installations along both coasts, with breaks of approximately seventy miles between stations. But at the time of Pearl Harbor there were only eight stations fully ready for operation: two on the east coast and six along the Pacific.[46]

Filter centers, which processed the raw data received from the warning nets, and the information centers, which on the basis of reports fed to them by surrounding filter centers alerted the defensive forces, depended upon elaborate fixed installations, with large floor space and special requirements as to ceiling height. The British used bombproof underground shelters, but American planners were pleased if they could get reasonably secure modern buildings.[47] It was hard to find available space which met the requirements, and especially so because of a federal statute of 1932 which made it impossible to rent a building if the annual charge exceeded 15 per cent of the market value of the property.[48] Costs for remodeling, moreover, could

not exceed one-fourth of the first year's rent. A way was found out of the latter difficulty by use of discretionary funds controlled by the President, but the law on leases was not relaxed until April 1942.[49] Before Pearl Harbor the interceptor commands had begun work on fifteen information centers and twenty-one filter centers in priority regions along the Atlantic and Pacific coasts.[50] Key members of the staffs were supplied by Signal Corps units, with civilian volunteers rounding out the necessary complement.

To test the effectiveness of the slowly developing network, the AAF conducted a series of exercises in the latter half of 1941. The I Interceptor Command carried out mock attack routines from 9 to 16 October, employing 1,800 observation posts along the coast from Massachusetts to North Carolina. The tests stimulated interest and thus aided the recruitment of volunteers, but they also revealed a dangerously loose operation of the warning system. No less than five separate raids reached Philadelphia without detection.[51] In the Carolinas and Georgia the III Interceptor Command conducted exercises for five days, beginning on 20 October; again entire flights escaped detection.[52] Along the west coast, the II Interceptor Command held inconclusive tests in the northwest in November, and the IV Interceptor Command in California was getting into position for a December exercise when war itself substituted a sterner measure of defense readiness.[53]

The concern with problems of air defense on the eve of Pearl Harbor had been by no means limited to questions of continental defense. Arnold had been unhappy over the results of air warning tests staged in connection with the Louisiana and Carolina maneuvers.[54] A board of officers charged to report on aircraft warning service (AWS) needs in connection with the Second Aviation Objective had stressed in October the fact that urgent demands for AWS assignments to overseas areas had left in this country only 1,100 trained men to serve as a "breeding stock" for the many AWS units that would be required.* Indeed, more than 17,000 air warning service troops had already been authorized for units in existence. It was recommended accordingly that the training of AWS specialists be given a priority "far above [that] for any other units in the U.S. Army."[55] As the board itself put the point, concepts of "pursuit operations during the last year [had] been revolutionized" by developments in aircraft warning techniques.

* There had been 3,644 men dispatched to key garrisons overseas.

Despite objections from those in the War Department who wanted to take the calculated risk of occasional attack, the nation embarked on an ambitious air defense program after Pearl Harbor. The warning net was greatly strengthened, and gradually there were added those elements of defense which could provide a system comparable to the British model.

Until the Battle of Midway in June 1942 removed much of the fear that Pearl Harbor could be duplicated along our own coast line, efforts to strengthen air defenses proceeded on much the same basis as did attempts to provide emergency aid to the defense of Alaska, the Panama Canal Zone, Hawaii, and the Philippines. Reinforcements were rushed to the Pacific coast, where alerts began on 8 December 1941. Three days later, Category of Defense C was ordered for both of the continental coasts, which was to say that minor attacks could be expected "in all probability."[56] Civilians quickly made possible an extension of the warning net by volunteering as observers or as personnel to staff filter boards and information centers. But inexperience, inadequate equipment, and poor organization produced the inevitable confusions. The culmination—a disturbing augury for defense capabilities—was the hysteria which accompanied the so-called "Battle of Los Angeles" in late February 1942.* As for the capabilities of the AAF itself, the Air War Plans Division early in February informed Arnold that there was "little probability that air force units as now constituted could defend vital targets against a determined carrier-based attack."[57]

As a device to conserve the limited forces available, the AAF had proposed in December the creation of a western air theater for command of all air operations along the Pacific coast. This theater would operate under the direct control of the AAF, and its establishment was viewed as a step toward assuring unified control of all defensive air units without regard to the geographical limitations imposed by the relative immobility of other forces. A memo to the Chief of Staff pointed out that there was no immediate threat of invasion except by air and argued the dangers of subordinating air defenses to any ground command: "Both coasts of the United States are threatened by air attack. Considering the small forces now available for defense, it is imperative that they be disposed, moved, and employed to the best advantage. This may require frequent transfer from one coast to the

* This incident and early air defense operations have been described in Vol. I, Chap. 8.

other."[58] General Marshall, holding to another principle of united command, on 11 December 1941 designated the Western Defense Command as a theater of operations with control over the air organizations stationed within its limits. A parallel action with reference to the east coast on 20 December closed the door on AAF proposals for independent air theaters. But Marshall informally made a concession to the airman's point of view. By telephone on 12 December he advised Lt. Gen. John L. DeWitt of the Western Defense Command "to be very cagey in his application of supreme command as it applies to the Air Corps."[59] Specifically, DeWitt was ordered to respect the integrity of the air defense organization built up by the interceptor commands. Discussion of an independent air theater continued, but no action was taken.[60]

With two theaters of operations now activated, the War Department made a necessary adjustment of jurisdictional boundaries for the continental air forces on 30 December 1941.[61] The Fourth Air Force took over the entire west coast as the air arm of the Western Defense Command, while the First Air Force was similarly assigned to the Eastern Defense Command along the Atlantic front. In the regrouping the Second and Third Air Forces were given training as a primary mission.*

The establishment of air defense zones served to define the areas most vulnerable to hostile air attack, and thus to facilitate the fixing of priorities for the completion of warning nets and for the assignment of defense units.[62] Within these zones special flight restrictions and blackout rules were enforced. The zones, extending inland approximately 150 miles and out to sea for a distance of 200 miles, were subject to redefinitions as conditions dictated. In November 1942 a special Vital Air Defense Area was created on the east coast to emphasize the priority given to key cities from Boston to Washington, D.C.[63] The interceptor commands—after May 1942 called fighter commands—depended upon regional subdivisions within each zone. The term "region" had come into use in 1941 to indicate the territory served by one information center of the AWS net, as with the Boston Region. For so long as the regional center had merely headed up a communications net, the logical commander was the Signal Corps officer in charge of its information center. But when fighter planes were assigned to some of the regions after Pearl Harbor, the com-

* See above, pp. 72–74.

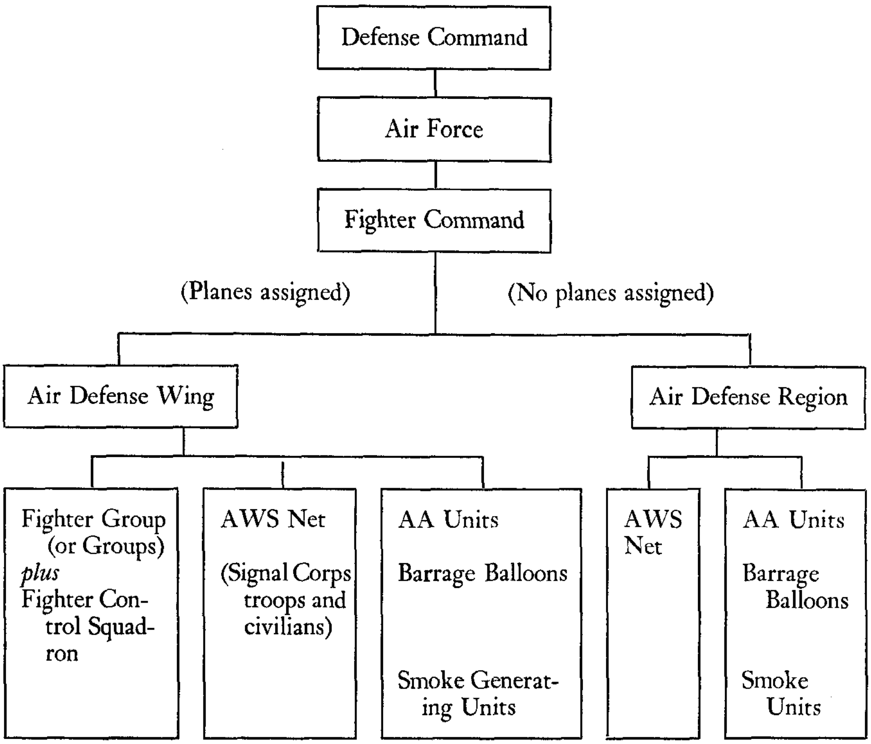
manding officer of the fighter unit became chief controller and regional commander.[64] The controller gave orders to the three elements of active air defense—Air Corps planes, Signal Corps warning units, and Coast Artillery AA—and also regulated air traffic, blackouts, and radio silences. Since no tables of organization existed at first to provide staffs for the regional commander, members of the fighter unit were detailed to key posts under an arrangement whose weakness became obvious upon transfer of the tactical unit outside the region.[65]

To offset this difficulty air defense wings were established in August 1942.[66] A wing consisted of a commanding officer and staff charged with responsibility for both tactical and administrative activities; under the new arrangement tactical units might be assigned and reassigned without disturbing the continuity of organization. Four wings were assigned to the east coast: at Boston, New York, Philadelphia, and Norfolk. Below Norfolk, where combat units had not been assigned to air defense regions, there were no wings, but the regions got permanent AAF staffs in January 1943.[67] The west coast received three wings, based at Seattle, San Francisco, and Los Angeles. For a brief time Portland, Oregon, was given wing status, but for most of the war it was a region attached to the Seattle Wing. Similarly, San Diego normally operated under the Los Angeles Wing.[68] The chart on the following page, taken from an AAF manual of May 1943,[69] shows the basic relationships.

The curious reader may wonder just where, if at all, AAF Headquarters fitted into the 1942 air defense organization. It has already been noted that a campaign to secure direct control of air theaters by the AAF failed and that the First and Fourth Air Forces had been taken away by assignment to the defense commands. As a result, it may seem that no defense role was left to the AAF; but the appearance is most misleading. Actually, the AAF had guided the development of air defense at all points since the middle of 1941. At AAF Headquarters after June 1942 a Director of Air Defense, Col. Gordon P. Saville, was responsible for developing tactics and determining requirements in personnel and equipment. At Orlando, Florida, the newly created Fighter Command School (after October a department of the AAF School of Applied Tactics) established a model of the British defense system for indoctrination of key American personnel in the principles of a unified air defense. Orlando served too as the headquarters for an air defense board which sent traveling

teams to inspect existing defenses and conducted studies for their improvement.[70]

As these developments suggest, the goal set by the AAF in 1942 was the attainment of a scheme of defense comparable to that already operational in Britain, using new radar devices for controlled interception. The advantages of such a system had been outlined by



Saville in the fall of 1941,[71] when he had listed the several possible methods of defense. In the absence of provision for early warning by radar, the air force might try to maintain search patrols by plane, but only at enormous cost and with unrewarding results. If no more than a late warning could be assured, such as that provided by ground observers stationed close to the target, defending planes would have to remain constantly on air alert, ready for last-minute interception. It was estimated that the cost of maintaining planes over the target would be a fourth of that required for effective search patrol, but the cost would still be great and the degree of security afforded slight.

With radar to provide a twenty-minute warning, it would be possible to conserve both planes and pilots by keeping them only on a ground alert; and if the interceptor command could use ground-to-air radio to direct intercepting planes, a ground alert might be thirty times more efficient than a system of search patrols. The current HF radio equipment made two-way communication between ground and plane almost impossible, because of the limited number of channels free from interference. But the newly developed VHF radio promised the tremendous advantages of directed interception by ground agencies which would have the latest information from the warning nets. GCI (ground controlled interception) equipment developed by the British already had brought within reach the prospect of an all-electronic system of control, taking fighter pilots "to the very tail" of the enemy in all conditions of weather, whether by day or by night.* As yet, efforts in the United States had been limited to provision of early warning, but Saville considered the work done "a framework upon which a highly organized interception service could be superimposed should the United States be subjected to sustained or important air attack."

It should be noted again that the AAF's concern with the problems of air defense was by no means limited to questions of continental security. Except in Britain, where the RAF brilliantly protected U.S. installations and forces from enemy air attack, the AAF carried a vital responsibility for air defense in all overseas theaters of operations. It was in connection with the original concern for an air defense of the United States that AAF leaders developed the doctrine, equipment, and organization which made possible the successful performance of this mission at so many critical points around the world. For example, the fighter control squadron—a specially equipped and trained unit intended to serve for ground control of fighter operations—had its origins in the fall of 1941† and served in each of the air defense wings established in 1942 to implement plans for controlled interception but made its chief contribution to the war effort in such remote spots as Biak or Hollandia. Though it may well be that the government went beyond what was actually necessary for continental air defense during the first part of the war, the expenditure should by no means be considered a total military loss.

* For description of the various radar and radio devices employed by the British for purposes of controlled night interception, see Vol. I, 288–89.

† See below, p. 105.

Air Defenses of World War II

At no time during the war was complete uniformity of practice in air defense achieved.[72] Nevertheless, it is possible to draw in outline the system approximated in most places.

The war led to a major expansion of radar coverage. Eventually, construction was completed at ninety-five sites, sixty-five on the Pacific and thirty on the Atlantic coast.[73] Many of the sites were later abandoned; the maximum number of radars in use at any one period was approximately seventy-five. Radar installations—which were not one piece of equipment but a complex family of electronic aids—ideally supplied defense forces with the following information: the presence of planes as far as 120 or more miles to sea, the approximate number of the planes, their distance from shore, the direction of their flight, the height at which they were flying, and whether the forces were friendly or hostile.[74] The major weakness of such equipment was that it could not with certainty detect low-flying objects and that it could yield false echoes if the set was not sited and operated with precise skill. It was unfortunate that prewar plans had been based on the old SCR-270 and SCR-271,[75] which could tell little more than the direction and distance of approaching planes. With later modifications this equipment yielded better coverage, but in the critical period it gave only a very crude early warning. The sets had no height-finding facilities, were hard to adjust, often showed blind lanes, were vulnerable to enemy jamming, and (in 1941) suffered from very poor site selection and from a critical lack of calibration. A visiting British expert, Sir Robert Watson-Watt, early in 1942 described the sets as having only one merit: availability.[76]

Other equipment had to be used to supplement the basic radar net. Some data were provided by a short-range radar used by AA units. This SCR-268 set detected low-flying planes at distances up to twenty-five miles and had a converter which computed the altitude of targets at ranges up to eleven miles.[77] These AA radars, usually deployed close to priority targets, were not normally part of the coastal warning net, but along the west coast—after June 1942—data from the SCR-268's were relayed to information centers to augment coverage by SCR-270's.[78] For more complete protection against low-flying planes a modification of the AA set, renumbered SCR-516, increased the range to seventy miles.[79] Better technical aids became available during the war years. For close-in coverage (at ranges up to fifty

miles) GCI radars, SCR-588 for instance, could track enemy and friendly fighters in a single scope, supplying data on elevation, range, and direction.[80] For early warning offshore the answer was microwave radar. The problem of defending the west coast inspired the radiation laboratory experts to produce a "Big Bertha" of radars, a powerful set using a million watts of power and with vision so broad as to require four scopes to report what it saw.[81] Such sets came into use in 1944, but were first used in Europe rather than for home defense.

Because of anticipated Japanese raids along the Pacific coast, an especially elaborate radar net was developed to guard the 1,200-mile frontier from Seattle to San Diego. By the end of December 1941 the ten sites selected before Pearl Harbor were in use, with work under way on additional sites.[82] By late May 1942, during the tension before Midway, there were twenty-five SCR-270's, but many were poorly sited. West coast coverage was termed inadequate by the AAF traveling air defense board that summer; consequently, an extensive radar coverage project was prepared by IV Fighter Command in August. The new plan called for seventy-two stations to provide overlapping coverage for the entire coast, with "fortress-type" nets at Seattle, San Francisco, and in the Los Angeles–San Diego area. Eventually radars operated from sixty-five sites, many of them still unsuitable. A better measure of the final system was the net operating in June 1943: of thirty-eight sets then in use, twenty-two were SCR-270's, one an SCR-271, ten SCR-516's, and five SCR-588's.[83] In addition, flank approaches were covered by stations set up with the cooperation of Canada and Mexico.

Along the east coast the I Fighter Command was responsible in 1942 for the radar net from Maine to Florida. Priority was given to siting fifteen stations to cover vital industrial centers from Maine to Virginia, a project completed by the end of August 1942. Farther south, from North Carolina to the tip of Florida, another project for fifteen radars was finished late in 1943. Radars planned for the cities of western Florida were never installed, nor did III Fighter Command get equipment for the Gulf coast net it had projected. The basic radar for the sites along the Atlantic was the long-range SCR-270, supplemented by the shorter-range SCR-516, and by one GCI set which was assigned to Long Island to cover New York City. During 1943 the SCR-270's were generally replaced by their fixed-station companion, the SCR-271, although the change-over was never complete.[84]

The original War Department instructions on siting had prescribed locations on hilltops, but experience proved the directive faulty;[85] nearly all stations sited in 1941 had to be moved lower. Heavy direct costs at each site were involved in building access roads, power facilities, and housing. The Chief of Engineers tried to hold costs to \$40,000 per site, but in 1942 actual project expenditures along the Pacific coast averaged more than \$80,000 for mainland stations, and over \$100,000 for island installations.[86] Radar calibration was expensive in a different way. It was a highly technical process which involved checking plots against controlled flights in every sector of the operating range of a station. To calibrate a single set often required 9,000 miles of flying; performance tests to show the range within which targets could be detected and accuracy tests to spot errors in azimuth, range, or height were also necessary.[87] The I Fighter Command started calibration of Atlantic radars in April 1942 and a similar project for the west coast began the next month, but even in mid-1943 many stations were incompletely calibrated.[88]

The network of volunteer ground observers covered the seaboard areas of the United States, on the Atlantic side as far inland as Pittsburgh. By February 1942 about 14,000 posts had been provided, 9,000 along the east coast, 2,400 on the Pacific, plus another 3,000 along the Gulf coast.[89] It is impossible to determine the exact number of observers who served, but an AAF estimate of April 1943 put the figure at 1,500,000 persons.[90] The volunteer spotters had no official organization beyond that of local units until 15 July 1942, when the War Department created the AAF Ground Observer Corps.[91] The job of these observers was to supplement the radar net by reporting the movements over land of all aircraft. As a plane appeared near his post, the observer reported to a filter center, usually by commercial telephone, giving a message such as this: "Army flash . . four . . bi . . high . . seen . . NW . . 3 . . SE." In translation, four biplanes had been seen flying at high altitude three miles northwest of the post, heading southeastward. Adjacent observers, spaced six or eight miles apart, filled in the track as the plane moved along its course.[92]

Qualifications for service in the observer corps were very modest. The official Army field manual specified that "observers must be able to speak English clearly and distinctly, and should have good eyesight."[93] The chief requirement actually became willingness to serve in a task which quickly became distinguished by its monotony. People

to man the posts came from all social groups: in California, convicts at Folsom Prison, priests at Alma College, and paupers at an almshouse shared with Henry Fonda, the actor, the democracy of the spotting service.[94] The posts at which the observers worked were at first crude makeshifts. If telephone service was available, any shelter would do: a shack, garage, tool shed, school, even a bus hauled to the edge of a cliff. After Pearl Harbor local ingenuity improved the quarters to protect volunteers from rigorous weather. In outlying sectors where population was sparse, supplementary use was made of Coast Guard stations and fire towers.[95] Because observers were not subject to military discipline, some authorities believed that volunteers should be replaced by a paid staff, and the War Department early in the war considered a plan to pay them $30 per month. Further study, however, showed that the payroll on the Pacific coast alone would be approximately $1,000,000 per month, and along the east coast would amount to three times that sum.[96] Moreover, the small pay might not have attracted suitable personnel and would have raised questions about pay for all civilian defense volunteers. Both President Roosevelt and Secretary Stimson strongly favored the volunteer system,[97] and no action was taken to change it.

Serious morale problems remained. After the first burst of enthusiasm, public interest had to be systematically sustained. Rumors of the "magic eye" of radar caused many to doubt a need for the work done. Others complained because of difficulties experienced in getting funds for telephones, light, fuel, and transportation; after October 1942 the Army paid for telephones used exclusively for AWS calls.[98] A more serious grievance was voiced by observers who were denied tire and gasoline rations to cover travel to observer posts. No general solution was found for the tire-replacement problem, but after December 1942 the Office of Price Administration allowed extra gasoline coupons when requests were endorsed by chief observers.[99] Fundamentally, the observer system depended on patriotic self-sacrifice, but a number of special programs were developed to help sustain morale. To recognize service of 100 hours an arm band was given, and by 1943 silver medals were awarded to recognize varying periods of service up to 2,000 hours. After February 1942 a magazine, "Eyes Aloft," was distributed to observers on the Pacific coast, and a month later east coast volunteers began to get copies of "The Observation Post."[100]

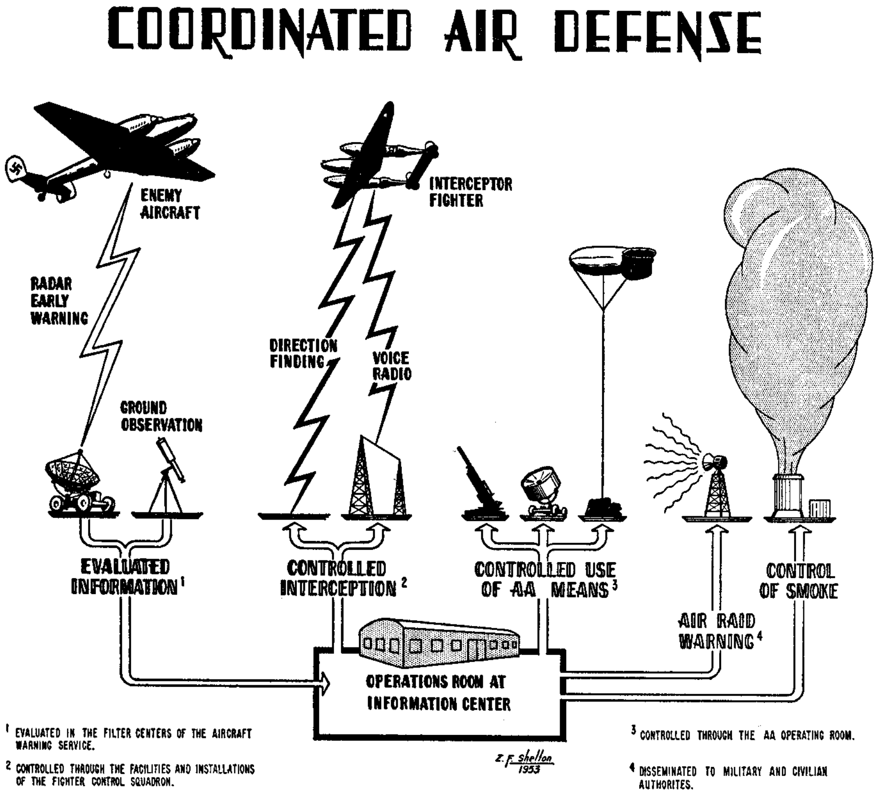
Initial operations showed serious weaknesses in the ground observer

system.[101] Partly because of faulty spotting and partly through lack of standard procedures, reports were often useless. Observers had no mechanical equipment to help them, although at the time the net was inactivated some orders had been placed for the "Sadowsky Spotter," a device which helped compute the height and distance of planes from posts.[102] A grave defect of the observer net was the congestion on filter boards caused by reporting all plane movements. In February 1942 observers near Philadelphia and Washington were told to cease reporting commercial flights, and by 1943 efforts to report all planes had been abandoned in other vital air zones.[103] Ideally, observers should have been trained to recognize planes by type, and early in 1943 the I Fighter Command began to give key observers eight weeks of aircraft-recognition training, in the hope that they would undertake a teaching mission among their fellows.[104] But by this time the system was being inactivated.

Observers and radars, the ears and eyes of defense, supplied the raw data of the AWS, but an extensive filtering process was required to reconcile conflicting reports. Data from coastal radars went to radar filter boards at the information centers. After Pearl Harbor separate radar filter rooms were established at some centers, and in 1943 such radar rooms were compulsory for all centers receiving reports from three or more radars.[105] In the filter room plotters located the reported flights on a map superimposed upon the filter board. A filterer studied the positions thus indicated for the purpose of determining the "actual" position and direction of any given flight of planes. An identification officer, in consultation with representatives of the Navy, AAF training commands, and the CAA, undertook to eliminate tracks made by friendly planes. Meantime, a speed orderly studied the plots to calculate the rate of approach. The first phase of filtering was thus completed: the location, altitude, speed, and number of planes in any flight considered to demand further attention had been estimated. At this point a teller, connected by direct telephone to the operations board of the information center, relayed the data in condensed message form.[106] The entire procedure—except for identification—was repeated as additional reports came in from the radars. As the flight came over land, reports from ground observers were routed through special filter centers, from which tellers reported by telephone to the operations board in the information center.[107]

The information center linked all elements of the warning service.

Like the human brain, it received warnings, weighed and evaluated them, and issued orders for action. In the operations room some information centers maintained two boards, a horizontal one for data originating with ground observers and a vertical board for radar reports; other centers combined the two into one large horizontal board. In either case, plotters displayed on the boards the data relayed from the



tellers, using "target stands" to describe the flight and arrows to indicate direction of movement. The operations board thus reproduced every flight displayed on all filter boards within the region. If identification had not been made at filter centers, liaison officers were queried to determine if flight plans indicated the nature of the flight. In the event a hostile flight was suspected, the information center issued the signals for action: to the air force for fighter interception, to the AA batteries for gun defense, and to civilian defense agencies for passive defense.[108] Unfortunately, the system was so complex that

no way was ever found to make identification infallible in areas of heavy air traffic densities.

The physical setting of the information center matched the drama of its role as a nerve center of the AWS. On a balcony overlooking the operations board was stationed the controller, the officer who commanded all air defense activities in the wing; he was surrounded by a pursuit officer, a radio officer, a radar officer, an antiaircraft officer, plus liaison officers from the bomber command, the Navy, the Civil Aeronautics Authority, and the civilian air raid organization. In addition, he was assisted by a FCC representative who relayed orders for radio silence and an air officer who was responsible for alerting civilian warning districts. The controller was linked by telephone to his intercept officers—in another room—who stood ready to direct fighters to meet any hostile flights. The information centers were costly, even though built as temporary installations in leased quarters. Rental at New York City, for instance, came to $46,000 per year, and initial equipment and improvements cost more than $140,000.[109]

To maintain and staff the filter and information centers required a complex organization. Wing controllers and some staff assistants came from AAF units, and communications specialists were drawn from the Signal Corps.[110] But the majority of plotters and filterers were civilian volunteers, chiefly women. Unlike the ground observers, prospective volunteers at the filter and information centers had to be fingerprinted and interviewed by intelligence officers before they could serve. Security regulations were strict, and training was much more complicated than for most volunteer defense tasks.[111] For that reason a key problem was careful recruitment; all the major air defense wings had to conduct repeated drives for personnel. The creation of the Women's Army Auxiliary Corps in May 1942 promised to solve the problem by providing uniformed personnel, and WAAC units were, in fact, assigned to I Fighter Command centers beginning in October 1942.[112] The experiment did not work out, in part because the WAAC's had expected to replace soldiers rather than civilians, and in part because the AWS volunteers did not see why WAAC's should be paid for doing work that they themselves did without compensation. On 9 February 1943 the War Department ended the experiment by ordering WAAC personnel withdrawn from all AWS posts for which civilians could be recruited.[113] The return to a volun-

teer staff led to the creation of the AAF Aircraft Warning Corps, for which regulations were prescribed on 7 May 1943.[114] Its volunteer members were to be appointed by the fighter commands, were to be at least eighteen years of age, and were to be citizens of the United States or another of the United Nations. They were to serve without pay but could be reimbursed for transportation or for meals made necessary by duty schedules.[115] The warning corps was organized on both coasts in July 1943, incorporating volunteers already on duty.[116] To recognize service the corps issued wings and medals, often with formal military presentation ceremonies.[117]

At its maximum size the AWS net worked through fifteen active information centers along the Atlantic and Pacific coasts and had four stand-by centers along the Gulf coast. On the east coast, centers at Boston, New York, Philadelphia, and Norfolk went into operation right after Pearl Harbor; by February 1942 supplementary information centers had been set up in Buffalo and Albany. Farther south the centers at Wilmington, Charleston, Jacksonville, and Miami were essentially complete in 1941 but could not become fully operative until the observer nets were completed and personnel trained. After February 1942 this entire eastern net was put under I Fighter Command.[118] Each of the information centers also housed a filter center, and additional filter centers at separate locations served most regions. The Pacific coast net, assigned during the war to IV Fighter Command, utilized five information centers: at Seattle, Portland, San Francisco, Los Angeles, and San Diego (the last named, completed in June 1942, operated as a subcenter of Los Angeles).[119] Along the Gulf coast, the Third Air Force had established by May 1942 stand-by centers at Mobile, New Orleans, Houston, and San Antonio.[120]

The aircraft warning system, as it operated in 1942, did not assure prompt identification of all flights. A visit by Secretary Stimson to key installations led to a War Department letter of June 1942 demanding greater efficiency.[121] In reply, IV Fighter Command reviewed some of the problems inherent in a volunteer net: incomplete coverage of land areas by observer posts, shortage of civilian personnel, sloppy work by some observers, and confusion of two or more flights by plotting personnel.[122] The last type of error was caused by the congested boards at filter centers, an outgrowth of the heavy air traffic created by training flights and the civil air lines. At Philadelphia, for example, facilities designed to handle 6,000 calls per day

sometimes took care of as many as 20,000 messages—even an average day brought 8,700 calls.[123] In the Los Angeles Region there were approximately 115,000 training flights in the single month of July 1942.[124] Such burdens on the AWS were perhaps inevitable in areas which were both defense zones and training regions, and no complete solution was achieved. Considerable progress was made in 1943 in integrating AWS operations with civilian airway traffic control centers,[125] with the intelligence nets of AA commands,[126] and with bomber commands and Navy sea frontier units (through joint operations centers).[127] The identification of planes approaching from seaward was simplified after mid-1942 by the gradual introduction of IFF (identification friend or foe) radar, but pilots were lax about turning on the sets—in one test 80 per cent of the craft plotted did not show IFF—and equipment was difficult to adjust.[128]

In addition to its functions in active air defense, the AWS net provided the signal which triggered the civilian defense system. Local and state defense councils, coordinated by the Office of Civilian Defense, recruited volunteers to serve as air raid wardens, fire-fighters, or members of decontamination squads. The civilian air raid warning (CARW) system provided the link between the military net and the civilian defense units. The machinery worked very poorly at the start of the war. It took more than an hour and a half for an alert ordered in Boston on 10 December 1941 to take effect in outlying parts of the region.[129] Soon, however, the color warning system of CARW became household information: yellow alerts brought wardens to duty, blue alerts led to public warning of the raid, and red alerts (planes within 25 to 40 miles) mobilized the entire passive defense machinery.[130]

The principal agents of active defense—those capable of destroying enemy craft in the air—were fighter interceptors and antiaircraft artillery. The former, guided by the radio communications of fighter control, provided the first line of defense for an entire air defense region; bombers were on call for service in striking forces to be directed against enemy carriers offshore. AA batteries and barrage balloons, stationed around key targets, supplied a last-ditch defense.

Fighter aircraft, properly controlled, were the key to successful air defense. The planes with their tactical mobility could concentrate quickly from dispersed bases; therefore, they could defend a whole group of objectives with a force adequate to defend any one point of

attack.[131] The fighters needed about fifteen minutes to take to the air and attain an altitude of 20,000 feet.[132] The fighter wings, which commanded all fighter units in a region,[133] were represented at the information center by controllers who issued the order for interception and then turned the mission over to an intercept officer who, from his own station in the information center, directed the fighters to the vicinity of the enemy flight.[134] Once contact had been made, control passed to the flight leader, but until then the fighters maintained constant communication with the intercept officer by means of an air-ground radio net operated by the fighter control squadrons. Thus the interceptors could adjust their course to compensate for changes in direction or speed of the enemy flight as tracked by the AWS net.[135]

At the start of the war both the Atlantic and Pacific coasts had chains of radio stations, all equipped with HF. The eastern net consisted of fourteen stations and the western of twelve. But coverage expanded rapidly in 1942; by the end of the year the Philadelphia Wing had as many radio stations as the entire eastern chain had at the time of Pearl Harbor.[136] This expansion for a time continued to depend upon HF radio, but as VHF equipment became available for tactical units, beginning in the summer of 1942, necessary adjustments were made in the fighter control nets.[137] In the last half of 1942 extensive projects were drawn up for establishment of a series of VHF fighter control areas along the entire west coast and along the Atlantic coast from Norfolk north.[138] Under the new system, regions were subdivided into control areas, and in each area a fighter control center maintained a separate operations board to direct interceptions. The area board displayed the warning data developed by the AWS plus information on friendly planes supplied by the VHF net. Three direction finding (D/F) radio stations were spaced to form an equilateral triangle with forty miles along each side. The stations took simultaneous bearings by picking up a signal transmitted by a fighter plane; the exact location of the plane was speedily computed by triangulation. Radio contact between controller and interceptors was maintained by VHF voice radio through transmitters at the control center or at forward relays. At the conclusion of an interception a homing station guided the fighters back to base.

Critical equipment problems seriously delayed the completion of these projects. The IV Fighter Command secured War Department approval on 6 November 1942 for a western VHF net based on six

control centers, and a comparable east coast project for nine control areas was approved on 24 February 1943.[139] In addition to delays in provision of necessary equipment, there were revisions in plans and some difficulty in getting the desired sites; the first of the new control centers did not begin to operate until the summer of 1944. In the end, only three control centers were installed on each coast: in the east, on Long Island, in the District of Columbia, and at Langley Field, Virginia; on the west coast, at Paine Field to serve Seattle, at Berkeley for the San Francisco Bay area, and at North Hollywood in southern California.[140] Better progress was made in establishing the D/F, relay, and homing stations; by May 1944 the last of the obsolete HF stations was closed.[141] When the VHF nets had first been projected, plans called for all interceptions to be directed from the fighter control centers. But the delay in their establishment forced resort to a hybrid system in which the new D/F and homing stations were tied in to control agencies still operating from the information centers.[142]

Each air defense wing had at least one fighter control squadron to operate its ground-to-air communications. In key areas additional squadrons were assigned. Activated originally in the autumn of 1941 as Air Corps Squadrons Interceptor Control, these units had been reassigned in January 1942 to the particular pursuit group whose numerical designation they bore.[143] When pursuit planes were redesignated as fighters in May 1942, these new units became fighter control squadrons. The squadrons operated in scattered detachments, one for each radio installation. The usual problems of training were aggravated by the protracted transition to VHF equipment.[144]

A shortage of fighter aircraft during the early part of the war seriously crippled the defense system at its most critical point. In mid-January 1942 there were only twelve pursuit aircraft available for the immediate defense of New York City, and Norfolk had no fighters at all.[145] This weakness was partly the result of concentrations to meet a more serious threat on the west coast, where reinforcements in December 1941 brought strength up to 230 pursuit planes of doubtful value, but which could at least both fly and fire.[146] Deployed to cover a 1,200-mile coast, the force fell far short of the strength required to meet a major attack at any one point, even though all units were kept on alert for a time. The war, moreover, had caught the AAF in an early stage of a huge program of expansion which gave the highest priority to training activities for which

the very organizations charged with defense were partly responsible.* Planes and crews alerted for air defense had to suspend training activity, and those assigned to training were not immediately available in case of emergency. A typical rule in early 1942 on the east coast called for only one four-plane flight per squadron to be kept on alert from dawn to dusk.[147] With time it proved possible to use units in training as a source of reserve strength. The standing operating procedure of 22 March 1943 in the Philadelphia Wing provided that when the controller ordered a wing alert, all training flying was to cease. Assault flights (aircraft on ground alert) were to take to the air at once, and support flights (four planes per field to be always available within forty-five minutes) once aloft were to await orders. All other planes were to report their readiness state to the controller and stand by in reserve.[148] In a really serious emergency, planes could be flown from any point in the country, as happened when advance notice of the strike against Midway led to hurried reinforcement of the west coast at the start of June 1942.† The fighter defenses were always inadequate in 1942, however, and would have been especially impotent at night and in bad weather.

The other major dependence for active defense, antiaircraft artillery, lacked mobility. But for local defense AA was a valuable final line of protection, remaining in place even if fighters were decoyed out of the area. Moreover, AA could be ready to fire on shorter notice—in five minutes or less.[149]

AA organization was remade by the war. The Coast Artillery had been training scattered units in 1941, but after Pearl Harbor, unified AA commands emerged on both coasts. In the east, the First Army AAA Command (Provisional) was formed on 10 December and was retitled on 20 March 1942 the AAA Command, Eastern Defense Command.[150] In the Western Defense Command a full-fledged organization emerged on 9 January 1942 when the 4th Antiaircraft Command assumed jurisdiction over mobile antiaircraft units and barrage balloon battalions.[151] The new commands were put under the operational control of the interceptor commands by a War Department training circular of 18 December 1941 but were assigned to defense commands for training, tactical disposition, sup-

* See below, pp. 154–56, for discussion of the training responsibilities of the domestic air forces.

† See Vol. I, 299.

ply, and administration.[152] The antiaircraft commands were subdivided into regional commands to correspond with the air defense regions; each AA region was organized around a brigade as the key unit. At first the brigades were subdivided into regiments, but after September 1943 the latter were converted into groups.[153] Each group normally had a headquarters battery, a gun battalion, a searchlight battalion, and an automatic weapons battalion. This reorganization created self-sufficient units which could be transferred readily from one group to another.[154]

Effective coordination of guns and planes as partners in air defense proved to be a delicate problem and provoked considerable experimentation. The issues were especially acute in the Eastern Defense Command (EDC). There, in the spring of 1942, the tactical rule was that AA commanders could open fire on a target thought to be hostile, except in cases in which the controller specifically ordered gunfire withheld in order to protect friendly planes.[155] Whether because of the latitude given the AA, or because of interservice misunderstanding, several sharp disagreements between air force and antiaircraft units ensued. In the Norfolk Region in April 1942 the pursuit units complained that AA commanders were dictating landing procedures for the planes.[156] A conference of key men from the fighter commands on 21–22 May 1942, at AAF Headquarters, found existing rules extremely weak and insisted that the success of operational control of AA was "largely dependent on personalities." Fair success had been achieved on the west coast and in Panama, but " the situation in the Eastern Defense Command is bad." In the opinion of the airmen the problem could not be solved "until the antiaircraft artillery becomes a part of the Army Air Force."[157] Clarification of command lines resulted from an EDC order of 25 September 1942 which specifically recognized the I Fighter Command as coordinator of all air defense, including antiaircraft artillery operations.[158] General Arnold hailed the arrangement as "a progressive step forward," but he continued to seek integration of antiaircraft artillery units with the air defense forces.[159] Just such an experiment was finally given a trial late in the war. Effective 1 May 1944 the War Department removed the 4th AA Command from its assignment to Western Defense Command and placed it, instead, directly under the Fourth Air Force.[160] General McNair, for the Army Ground Forces, strongly supported this move, but there were many

opponents.[161] The experiment continued to the end of the war, but there were no active operations to test the value of the innovation. On the basis of the experiment, the 4th AA commander, Maj. Gen. John L. Homer, urged that AA be organized "as a distinct entity" within the AAF instead of being integrated with its command units.[162]

By 1943 Army doctrine had accepted the tenet that control of AA belonged to the air defense commander. Thus Field Manual 100-20 in July of that year laid down the following norm for relations: "When antiaircraft artillery, searchlights, and barrage balloons operate in the air defense of the same area with aviation, the efficient exploitation of the special capabilities of each, and the avoidance of unnecessary losses to friendly aviation, demand that all be placed under the command of the air commander responsible for the area."[163] Standard procedures to implement this doctrine had already evolved. By rules laid down in November 1942, wing commanders in the Eastern Defense Command coordinated fighter and AA units and issued rules to keep training flights out of gun-defended areas. Regional AA commanders disposed and employed gun units and ordered appropriate readiness states. Antiaircraft units were always to be ready for combat within two minutes and were to be alerted in a sequence coordinated with the color alerts used by the civil air raid warning system: a yellow warning (planes within 100 miles) put AA crews on alert; a blue warning put gun crews on stand-by status, ready for action; and on a red alert (planes within 25 miles) gun crews manned full action stations. Searchlights remained darkened during color alerts unless illumination was specifically ordered by the controller.[164]

The war gave new urgency to the disposition of AA in the United States. An ambitious project for AA in the Eastern Defense Command, drawn up on 10 January 1942, called for a maximum of 12 guns for each priority target along the Atlantic seaboard; this would have required 450,000 troops and 3,800 large (90-mm.) guns. At that time the command, in fact, had only 26,000 troops and 48 guns. If a defense comparable to that attained in Britain had been achieved, each EDC target would have had thirty-two guns assigned—instead of the maximum of twelve envisioned in the January plans.[165] But not even the more limited goals of the 1942 project would be fully implemented.

On the west coast a large number of vulnerable targets led to

speedy reinforcement of AA units in December 1941. First claim against AA resources was given to such vital targets as aircraft plants, naval bases, shipyards, airfields, and priority industries (petroleum, for example).[166] In January 1942 four brigades of AA with a combined authorized strength of 32,300 were assigned to the Pacific coast; peak strength, in January 1943, came to 42,860 men.[167] Because of inadequate training, combat readiness in early 1942 was very low.[168] Equipment was also a major problem, as one example will show: as late as August 1942, when the 90-mm. AA gun was replacing the 3-inch and when the 40-mm. Bofors was taking the place of the 37-mm. automatic weapon, the west coast brigades were still short 40 per cent of their weapons. Radars for the AA intelligence net were in even more critical supply, for out of 268 authorized sets, the brigades on the Pacific coast had only 94, or about 35 per cent.[169] At no time did the antiaircraft commands have enough men or equipment to defend all the priority targets in the United States against sustained attacks.

The role of AA in supplementing fighter defenses can be illustrated by the case of the Sault Ste Marie area. The famous Soo locks and canal, through which a large part of the iron ore passed to reach the steel mills in the Pittsburgh-to-Chicago area, was regarded by the War Department as a potential "Achilles heel of the United Nations' effort," because any interruption of traffic could wreck the munitions program. If the Soo locks had been damaged, railroad lines out of Minnesota's iron mines could have carried only about half the tonnages required.[170] In late February 1942 the only protection was that afforded by a single military police battalion, armed with eight machine guns.[171] Lt. Gen. Ben Lear, then commanding the Central Defense Command, tried in vain to get fighter planes assigned; the best that could be done was to prepare airfields for use in an emergency reinforcement.[172] Although the AAF could not assign planes, key air defense officers conceded that the importance of the locks gave the Soo area a priority second only to the Panama Canal for barrage balloon defense.[173] By May 1943 Sault Ste Marie was defended by an AA gun battalion, an automatic weapons battalion, a searchlight battalion, and a barrage balloon battalion. Total strength of these units was about 3,400, and equipment included sixteen large AA guns (90-mm.).[174] Earlier, on 29 September 1942, the War Department had established a Central Air Defense Zone—

similar to the coastal air zones—and had ordered restrictions on civilian flying.[175]

As the defenses provided for Sault Ste Marie show, barrage balloons were regarded as vital supplementary air defense equipment for important targets. The balloons denied air space to hostile planes, both by physical obstruction and by the psychological effect on pilots. The balloons lessened the danger of dive-bombing and forced hostile craft to stay at altitudes at which they could be more readily detected. When properly operated, the balloon barrages were not subject to surprise and were effective under poor visibility conditions. The function of the weapon was generally misunderstood; the balloon itself was merely a device to suspend a cable designed to "wing" aircraft in flight. The impact of a plane running into the cable set up tension waves which activated devices to free the cable from the winch on the ground and from the balloon. Parachutes on each end of the free cable created total drag on the order of six tons, more than enough to break off a wing or to stall a plane.[176] In World War II only low-altitude balloons operating up to 5,000 feet had much significance. Two types of balloon envelopes were developed: dilatable balloons with a single cell which expanded to adjust for changes in gas pressure as the balloon rose, and ballonet types which used two cells, an air cell and a gas cell which worked reciprocally to adjust for altitude changes. In 1942 production was standardized on two ballonet-type balloons, the D-7 and D-8, each approximately eighty feet long and thirty feet in diameter, and made of two-ply cotton fabric, neoprene-coated.[177]

The need for barrage balloons had received little attention before the Battle of Britain in 1940, when the Army allotted $50,000 for balloon research.[178] The Air Corps waged a campaign to take over direct control of the program, but the Coast Artillery continued to be the using agency, and after March 1942 the Corps of Engineers became the procurement channel.[179] The Air Corps furnished cadres to help organize a training center for balloon detachments in 1941, a center initially located at Camp Davis, North Carolina, and later moved to Camp Tyson, Tennessee.[180] The start of war produced such urgent calls for balloons that the school battalion was dispatched from Camp Davis to the Canal Zone, and three out of four newly trained battalions were sent to Pacific coast assignments. By May 1942 the west coast had six out of a total of ten balloon battalions;

of the remaining four, two battalions were in the Canal Zone, one was at Sault Ste Marie, and one in Hawaii.[181] Along the west coast, barrage balloon commanders functioned under the regional AA command, except during alerts, at which times orders came from the controllers of the air defense wings of the IV Fighter Command. Even when raids threatened, barrage balloon commanders decided whether conditions permitted safe employment of the balloons and prescribed the operational height of the barrage if one was raised.[182]

Tactical use developed grave questions about the value of the barrage balloons. Old British surplus-type balloons at first pressed into use tore easily or the plies pulled apart.[183] The hydrogen gas used in the balloons proved dangerous; in January 1943 exploding gas invaded a personnel shelter, killing one soldier and injuring five others.[184] Moreover, the balloons had a tendency to break loose in storms, trailing cable in hazardous fashion. In Seattle on 5 June 1942 great winds tore loose fifty-seven balloons, and similar instances showed that rules based on British practice could not be applied along the Pacific coast.[185] After June 1942 a compromise rule kept the balloons at 1,000 feet when in readiness, instead of the 5,000 feet prescribed earlier.[186] Even so, critics continued to oppose the use of the balloons, on the ground that they menaced property and friendly pilots, and that they actually advertised the location of the targets they were supposed to defend. In November 1942 a report to the Assistant Secretary of War pointed out that the barrage at the Douglas aircraft plant at Santa Monica, California, destroyed the value of a $2,500,000 camouflage project.[187] At the same period an escaping balloon cut electric service to the Douglas factory, causing the loss of 6,000 man-hours of work.[188] In June 1943 the Truman Committee repeated basic questions about the value of the barrages. Western Defense Command urged that the balloons be kept in use, but the War Department on 18 August 1943 ordered the balloon battalions inactivated.[189] This decision did not, however, pass a final verdict on the value of the balloons, for by then air defense no longer had any priority.

The Stand-by Air Defense Pattern after 1943

The elaborate continental air defense developed after Pearl Harbor never had to operate against a major enemy attack. During the months from Pearl Harbor to Midway, when defenses remained on

a Category C alert, there were alarms, but happily they were false—the worst effect being tension among the defending forces. After Midway, occasional alerts were called; during 1942 on the west coast there were 18 blackouts, 30 radio silences, and alert measures were instituted on 25 other occasions.[190] The tedium for defending forces was also broken by some rather elaborate mock raids carried out as joint exercises with other military units and the Navy frontier forces.[191] There were even a few sporadic signs of enemy activity, of which the Mount Emily episode, 9 September 1942, was the most important. On that date an observer near the California-Oregon border saw a single-float biplane cross the coast from seaward. The plane proceeded inland to the slopes of Mount Emily, in an area well known to Japanese timber buyers, where it dropped some incendiaries later identified as of Japanese manufacture. Fortunately, an unseasonable rain had soaked the forest the day before, and the fire from the incendiary bombs was easily controlled. The plane soon disappeared over the sea, but a few hours later a Navy patrol bomber attacked a submarine in the same area—presumably the one from which the plane had been launched.[192]

Three major arguments had been advanced in justification of the expenditures on continental air defense. One was strategic in the broad sense: the need for protection of industrial plants—of the economic arsenal which fed the world-wide UN offensives. A second motive sprang from the need to train AAF and supporting units in the radically new techniques of electronic air defense, a training, as previously noted, put to good effect overseas. A third consideration, less openly discussed, was political—to assure the citizenry that it would be protected against air attack. The three aims were not always compatible, and there were many who from the first insisted that the proper strategy was to take the calculated risk of such sporadic raids as the enemy might be able to mount. Manpower and other resources could then be concentrated on a more rapid build-up for offensive war. Very early in the war some of those in charge of production were inclined to complain about losses occasioned by the alerts,[193] but at that time advocates of defense held the upper hand. Indeed, a government which before hostilities had seen fit to institute measures of defense would have found it difficult to explain any other course of action than that taken in the months following Pearl Harbor.

After the Battle of Midway, however, those who favored the calculated risk became stronger with each passing month. By February 1943 the Joint Chiefs of Staff approved a report which found the danger of attacks against American coasts to be slight,[194] and in April continental coastal frontiers were reduced from Category of Defense C to Category B (minor attacks possible but not probable).[195] The unopposed landing of American forces on Kiska on 15 August 1943 added force to the argument that the coasts were free from danger except for nuisance raids. By that time, too, the AAF was impatient to recover control of the air forces assigned to the defense commands in order to employ them more fully for the training of combat air groups. In a memo for Arnold early in July, Brig. Gen. Laurence S. Kuter had argued for abandonment of blackout drills on the ground that they not only interfered with production but encouraged the wrong psychology. As he put it, we needed "no more practice on the losing side of the air war."[196]

Decisions announced in September 1943 began the dismantling, piece by piece, of the air defense machinery and substituted a streamlined stand-by system. The first orders, on 10 September, removed the First and Fourth Air Forces from their assignment to defense commands and returned them to the AAF.[197] On 20 September the War Department put all observation posts and filter centers on both coasts on an alert status, specifying that they be manned only at such intervals as might be required to maintain the efficiency of personnel.[198] Along the east coast, after 13 October, the observer system operated only for a four-hour period each Wednesday afternoon; on the Pacific coast a similar stand-by status went into effect on 16 October.[199] By 30 October the Joint Chiefs reduced the continental coasts to a modified Category A defense, newly defined for areas which would probably be free from attack, but in which, for political reasons, nominal defenses against sea or air attack had to be maintained.[200] Under Category A the air defense system remained organized but operated only at intervals. In November 1943 radar stations on the Pacific coast and those along the Atlantic south of Kitty Hawk ceased to operate on a 24-hour-per-day schedule.[201] War Department Circular 80, National Policy of Air Defense, issued on 23 February 1944, gave flying training precedence over air defense even in coastal zones.[202]

A further drastic reduction of air defenses resulted from the deci-

sion of the Joint Chiefs in April 1944 to inactivate the AWS net.[203] The plan involved dissolution of the Ground Observer Corps, reduction of the radar net, closing of the filter centers, and a transfer of responsibilities belonging to the old information centers to a small number of fighter control centers. AA protection for vital areas would continue. The first phase of the inactivation was the release of civilian volunteers, as of 29 May 1944. Secretary Stimson, announcing the step, explained that

> The Aircraft Warning Service, on a reduced scale, will be absorbed into installations used for the training of fighter pilots. . . .
>
> This does not mean that the War Department is of the opinion that all danger of enemy bombing has passed. On the contrary, a small-scale sneak raid is still within the capabilities of our enemies. We must win this war in Europe and Asia, however, and the calculated risk we are assuming in reducing our air defense measures is justified by the offensive power we will thereby release.[204]

During June and July the radar net was curtailed, the fighter wings and regions were disbanded, and the remaining filter and information centers were closed.[205]

The fighter control centers,* which in July 1944 became the mainstay of the stand-by air defense, had as their major missions air unit training and flying safety. On the east coast the I Fighter Command had established three control centers, integrating them with VHF facilities and the nine remaining active radar stations.[206] Along the west coast the IV Fighter Command had been inactivated, but the parent organization, the Fourth Air Force, directed the creation of provisional air defense units as the skeleton upon which a full emergency defense could be based. On the Pacific coast only three control centers and twenty-two radars were retained on an active status.[207] The provisional defense units functioned only once, to guard the UN conference at San Francisco which opened on 25 April 1945. In the absence of an adequate warning net, radar-equipped surface vessels were used to help guard against a surprise carrier raid. The Fourth Air Force also mobilized the headquarters of the San Francisco AAA Group (Provisional), plus a day fighter and a night fighter squadron, and alerted the Berkeley Control Group to direct interceptions. Close-in defense was provided by the 4th AA Command, a unit of the Fourth Air Force.[208]

During one tense week it appeared that the risk assumed by strip-

* See above, pp. 105–6.

ping the air defenses might have been a costly mistake. On 3 November 1944 word reached Washington that a new type of German submarine was presumed to have left a Norwegian port to deliver a V-1 rocket attack on New York City. The War Department, to avoid hysteria, refused to give any public warning, but instructed the First Air Force to support the Navy in patrol measures. An AA brigade, in the process of moving out of the area, was retained to bolster the harbor defenses of New York. For a week a continuous alert was maintained, but by 10 November it was clear that the report had been false.[209] That same week, however, on the other coast, the first discoveries were reported of a very different type of new weapon launched by another enemy.

Postscript: The Japanese Balloons

Although the Japanese had failed to exploit their Pearl Harbor success by follow-up attacks on the American mainland, they did contrive before hostilities ended to send against the United States the first intercontinental missiles to be employed in warfare. The search for such a weapon seems to have been triggered by the hope of retaliation for the Doolittle raid on Tokyo in April 1942.[210] After two years of experimentation, the Japanese had developed a bomb-carrying free balloon which depended upon prevailing winds across the Pacific to reach its target in North America. Beginning in November 1944, the Japanese launched no less than 9,000 of the new weapons. Large-scale manufacture of the balloons had begun in July 1944; by the following February monthly output had reached 5,578 units; altogether, about 16,000 balloons were made.[211]

There were two types: a few pilot balloons, equipped to send a radio signal, were made of rubberized silk on the mistaken notion that this bag was a superior container of hydrogen; a second type, designed to carry bombs or incendiaries, had an envelope made by cementing together five layers of very thin paper. The resulting sphere, 33 feet in diameter, could lift a load of about 300 pounds. Ingenious devices were used to sustain the flight of the balloon and to release the bombs. An automatic control device allowed hydrogen to escape as the balloon began to rise above 35,000 feet, and whenever it dipped below 30,000 feet another mechanism, using aneroids and a battery, activated fuzes to release sandbag ballast. When all the sandbags had been dropped, the bombs were released and a demo-

lition device destroyed the remaining gear—or so the theory ran. The balloons, which could attain speeds as high as 200 miles per hour, required from three to five days to complete the crossing.[212]

The revenge campaign began with the launching of the first balloon on 1 November 1944. On 4 November an American vessel off southern California salvaged the envelope of one balloon, and on 11 December the first discovery on the mainland was made at Kalispell, Montana. The balloons landed over a wide area, from the Aleutians to Mexico, and from California east to Michigan. Military authorities confirmed about 150 recoveries. At first it was thought that the salvaged fragments came from weather balloons blown off course, but by January 1945 enough bomb fragments had been identified to convince the Army that it was dealing with a serious weapon. As late as March 1945, however, the War Department was still uncertain as to which of the following might prove to be the primary purpose of the balloons: bacteriological or chemical warfare; incendiary and antipersonnel bombing; terrorization to produce diversion of American forces; transportation of espionage agents; or novel purposes not yet apparent.[213]

The very uncertainty about enemy intentions stimulated defense measures against the new weapon. As 1945 opened, the Western Defense Command and the Western Sea Frontier were made jointly responsible for defense against the balloons. A conference of interested agencies quickly found that the stripping of west coast air defenses had left only a skeleton structure: the sharp reduction in radars had left gaps in the warning screen, and even AA strength was very limited.[214] Before reactivating defenses, it was necessary to determine whether aircraft could destroy the balloons. Repeated attempts by Fourth Air Force units to track balloons produced only two successful interceptions: a P-38 pilot from Santa Rosa Army Air Field brought down one, and a P-63 pilot from Walla Walla trailed his target from Redmond, Oregon, to Reno, Nevada, before forcing it to earth.[215] Bad weather, inaccurate sightings, and the high altitude at which the balloons traveled, all contributed to the poor record of interceptions. To determine if radar tracking would help, the Fourth Air Force set up an elaborate project,[216] but by the time the equipment for the test was emplaced late in April 1945, the balloons had stopped coming. Meantime, a rigid news blackout had deprived the Japanese of all knowledge of the results of the

attack. This secrecy produced the only fatalities of the balloon campaign when, on 5 May 1945, six members of a picnic group were killed by a bomb they discovered in a wooded area near Bly, Oregon.[217]

It was fortunate that the balloons stopped coming before the tinder-dry days of summer could provide a test of the incendiary bombs' ability to start extensive forest fires. If the Japanese had been able to sustain their best launching rate of 100 balloons per day, and if they had armed the missiles with clusters of small incendiaries, there might well have been serious consequences in the western states.[218] As it was, the enemy got scant return for his effort.

CHAPTER 4

* * * * * * * * * * *

THE DEVELOPMENT OF BASE FACILITIES

"AN AIR force," General Arnold explained to a congressional committee in January 1939, "is a balanced compound of three essential ingredients—airplanes, combat and maintenance crews, and air bases."[1] Air planners, believing that any air force which did not keep aircraft, personnel, and base facilities continually in balance could not be an effective combat arm, accepted this definition as basic policy in programming AAF expansion during World War II. To them it was obvious that recruits would have to be provided housing and shelter before they could be trained and integrated into the Air Corps. But they also knew that the AAF, unlike other elements of the Army, depended upon its bases for fighting power, training effectiveness, and strategic mobility, for the bases were the core around which all air force operations revolved, the point from which all air missions started and to which they returned.

Each base, regardless of whether it was used for training or for combat, thus had to maintain facilities both for housing and sustaining its personnel and for performing the air mission. It had to maintain and operate runways, control towers, air communications equipment, weather apparatus, off-base navigational aids, night lighting devices, and synthetic training installations, as well as the extensive shops and warehouses required for the maintenance of aircraft and other equipment. As a unit of AAF command, the base had to supervise subbases, auxiliary fields, and bombing and gunnery ranges. The air depots had to have all of the usual base facilities, in addition to large shop establishments and warehouses needed for the more com-

plicated maintenance of Army aircraft and for the bulk storage of AAF materiel.

Within the United States these air bases had to be properly located for continental defense because the AAF, in addition to being a training and a service organization, had to maintain a striking force for home defense. For its defense mission the AAF needed bases and auxiliary airfields in each of the nation's possible theaters of war —in the northeast, southeast, northwest, and southwest. These fields had to be suitable for employment by bombardment, fighter, and air support aviation. The defensive mission also dictated that an additional number of fields should be so located across the center of the continent as to permit quick movement of air units from one defense area to another. As a training organization, the AAF required bases geographically so situated as to provide the most favorable weather for year-round operations. As a service organization, it needed air depots located where they could best fulfill the maintenance and storage requirements of the defense and training functions.[2]

To meet these requirements on the scale dictated by the expansion of the air arm in the years between 1939 and 1945 required an extensive program for the development of base facilities. From the total of 17 air bases, 4 air depots, and 6 bombing and gunnery ranges available to the Air Corps in January 1939, the AAF expanded to peak totals of 783 main and subbases and auxiliary fields, 12 air depots and 68 specialized depots, and 480 bombing and gunnery ranges. In 1939 the Air Corps had units and small detachments, one of which consisted of only three individuals, at seventy-six installations in the continental United States. By December 1943 it had a peak total of 2,252 installations of all kinds.[3] The capital investment in air bases and airfields showed an even larger increase. In June 1940 Air Corps facilities in use had cost approximately $100,000,000, much of which had been spent during World War I. By September 1945 air facilities in use had increased to a capital value of $2,991,606,485, a total which does not account for other construction developed for the AAF but disposed of before September 1945. Counting all work put in place for the AAF between June 1940 and August 1945, some $3,152,025,000, or 29.5 per cent of the total War Department construction expenditures, had been used for AAF command installations. In September 1945 the AAF was using 19,-698,993 acres of land, an area nearly as large as that of New Hamp-

shire, Vermont, Massachusetts, and Connecticut combined.[4] Whether considered in terms of money expended, materials used, or man-hours employed, the development of AAF base facilities represented a major part of the national war effort.

Status of Air Installations in 1939

The system of Army air installations in use in January 1939, with the world facing a second general war, was strikingly similar in its broad outlines to the hodgepodge of airfields hurriedly developed for training purposes during World War I. Although some new bases had been built and most of the older fields had benefited at one time or other by some improvements, the number of installations fell far short of the Air Corps' needs in 1939.

Five of the ten air bases assigned to the GHQ Air Force, the combat arm of the Air Corps, either antedated or had been acquired during World War I. These old bases were Langley Field at Hampton, Virginia; Mitchel Field at Garden City, New York; March Field at Riverside, California; Scott Field at Belleville, Illinois; and Selfridge Field at Mount Clemens, Michigan. Langley had been located in 1916 to serve experimental functions for the Army, Navy, and the National Advisory Committee for Aeronautics, but construction delays during the war had caused both the Army and Navy to turn to other experimental installations, and Langley had been developed as an Army flying field. The site for Mitchel had been leased as a storage area in 1917, but after the war it had been purchased and developed into a flying field for the defense of New York City. March had been leased for training flyers in 1918, purchased in 1919, and occupied by combat units in 1931. Scott and Selfridge, located in the center of the continent, filled no clear defensive mission. Scott had been leased in 1917 for flying training, had been purchased in 1919, and after 1922 had housed the Army's balloon school. In 1938 it was selected for development as the headquarters post of the GHQ Air Force which was to be moved from Langley. Although this move was never to be made, the work of dismantling the balloon facilities and building a new flying station at Scott was getting under way in January 1939. Selfridge had been leased in 1917, had been purchased in 1920, and during the two decades prior to 1939 had been developed as a pursuit base.[5]

The other five bases assigned to the GHQ Air Force were of

more modern construction. In 1929 and 1930 Congress had authorized the War Department to accept donated sites for Barksdale Field at Shreveport, Louisiana, and for Hamilton Field at San Rafael, California. Barksdale had been built with some view to its use in defending the Gulf coast, and Hamilton had been designed as a bomber base for the defense of San Francisco. Moffett Field at Sunnyvale, California, had come to the Air Corps as the result of an unwanted exchange of facilities between the Army and Navy, announced in 1935 as an effort to relieve duplication. The Army had been required to give up, in exchange for Moffett, Rockwell Field at San Diego, California; old Bolling Field at Anacostia, District of Columbia; and Luke Field, Oahu, Hawaii. Moffett had been built by the Navy between 1930 and 1934 as a dirigible base, but a declining interest in lighter-than-air craft had left no use for it. Although the Air Corps occupied the field in 1935, its maintenance costs, particularly on the dirigible hangar, which could not be dismantled, were regarded as excessive, and as a defense base it duplicated Hamilton. After the transfer of old Bolling Field to the Navy, the War Department had secured funds to build a new field, also called Bolling, directly to the south of the older installation. In 1939 the new station was just becoming completely operational.[6] Newest of the GHQ Air Force stations was McChord Field at Tacoma, Washington. Construction of this field had been authorized in the Wilcox Act of 12 August 1935, a statute which had also authorized the development of new bases in the northeastern and southeastern United States and in Alaska, and of air depots in the southeastern and Rocky Mountains areas of the United States. Although building had started on McChord's donated site in 1938, it was not to be ready to receive a combat group until 1940.[7]

The Air Corps Board had concluded in 1936 that all of the air bases authorized by the Wilcox Act were necessary for adequate defense of the United States, but funds had been made available only for McChord.[8] As late as 1939 there was still no air base in New England, although its industrial complex made it a prime objective for enemy attack; the southeastern United States and the entrance to the Caribbean were similarly unprotected. The technical inadequacy of the GHQ Air Force stations was also most apparent. Although the GHQ Air Force had protested in 1937 that the drainage, housing, and landing fields at its bases were inadequate, and aircraft

engineers had recommended that paved runways at least 7,000 feet long would be needed for the new types of heavy bombers,[9] none of the tactical stations as yet possessed such facilities.

The burden of the supposedly temporary World War I construction lay even more heavily upon the fields used for training in 1939. Only two of the seven fields employed for that purpose had originated after the First World War. Kelly Field, one of the three flying training fields located near San Antonio, Texas, to take advantage of the favorable weather there, had originated as the aviation cantonment of Fort Sam Houston and in 1917 had been formally established for pilot training. Except for an interruption from 1920 to 1922 when it had been used as a mechanics school, it had been a flying training station ever since. Flying training had begun at Brooks Field in 1918, and, except for the years between 1919 and 1922 when it had served a balloon school, the station continued to fill its original function. The single new flying school, Randolph Field, had been organized in 1928, and its pretentious plant had been built in the years which followed.[10] The two airfields used for Air Corps technical training were Chanute at Rantoul, Illinois, and Lowry at Denver, Colorado. Chanute had been leased in 1917 as a flying school, but after the war it had been used as a storage depot for aviation supplies. In 1921 the deteriorating plant had been reopened, purely as a temporary expedient, to receive the mechanics school from Kelly, but eventually all technical training had been moved there. Unfavorable weather prevented proper flying training at Chanute, and the plant was so overcrowded as to be a hazard to the health of its occupants. Yet in 1930 and 1934 proposals to move the school met so much political opposition that they had to be dropped. In 1937 a compromise finally permitted a part of the Technical School to be moved to a donated site near Denver, Colorado. In 1938 the Air Corps had begun to occupy the new station, Lowry Field.[11] Maxwell Field at Montgomery, Alabama, was the site of the Air Corps Tactical School. This property had been secured for an engine repair shop in 1917, but in 1921 the maintenance function had been moved to Fairfield, Ohio, and Maxwell had become a flying field. In 1927 permanent construction had been begun, and in 1931 the Tactical School had moved from Langley to occupy the new plant.[12]

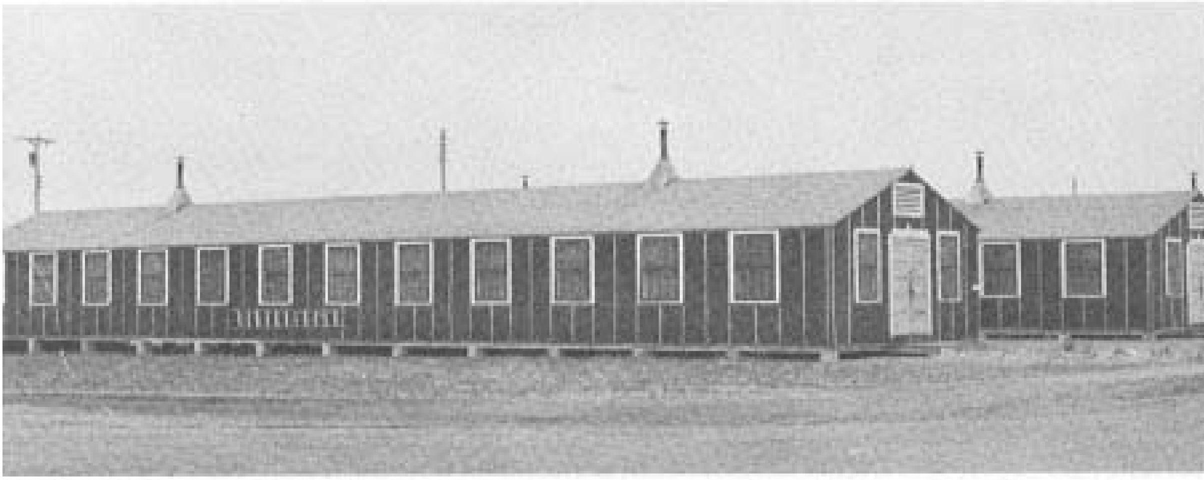
Both from the point of view of housing and technical facilities,

these training airfields—with the notable exception of Randolph—were ill equipped for their missions. Housing at Chanute, Kelly, and Brooks was largely of World War I origin.[13] The salubrious climate of south Texas prevented actual hardships to persons housed at Kelly and Brooks, but Chanute, overcrowded and run-down because of the long indecision on its fate, was a post which personnel avoided when they could. "Don't shoot 'em, Chanute 'em," had become a popularly conceived punishment in the Air Corps.[14] Maxwell, on the other hand, was one of the show places of the Air Corps because of its buildings and grounds, but it had a totally inadequate flying field. The OCAC estimated that a new station could be built for less than the amount of money which would be required to buy the land needed to bring Maxwell up to standard.[15]

The four air depots operational in January 1939 were closely similar to those which had remained in use after the First World War. The San Antonio Air Depot, opened at Duncan (later Kelly) Field, San Antonio, Texas, in 1917, was still being used in 1939. Middletown Air Depot, founded at Middletown, Pennsylvania, in 1917, was also still functioning although it was so restricted in area that authorities doubted whether it should be retained or abandoned. Fairfield Air Depot at Fairfield, Ohio, established in 1918 to service the wartime Wilbur Wright Field, had limited facilities in 1939. The Sacramento Air Depot at Sacramento, California, was the only new installation. Ground had been broken at its site in 1936, and in 1939 the old depot which had been at Rockwell Field was moved there. The headquarters of the Materiel Division, OCAC and the experimental and testing activities of the Air Corps were located at Wright Field, Dayton, Ohio, a postwar field which had come into use in 1927. Even in terms of peacetime requirements, existing depot facilities were no more than barely adequate; except for the new Sacramento warehouses, available storage space was filled. The total repair capacity of the depots, measured in terms of a unit representing the complete overhaul of one aircraft, was but 3,400 units a year. Both the San Antonio and Middletown depots were physically incapable of any great expansion: Middletown was crowded between an urban area and the Susquehanna River, and San Antonio was circumscribed by railway tracks and Kelly Field. Patterson Field at the Fairfield Air Depot had no improved runways, and during bad weather heavy aircraft landed there with difficulty. Olm-


RANDOLPH

EXPANSION OF LANGLEY FIELD, VA., JANUARY 1941

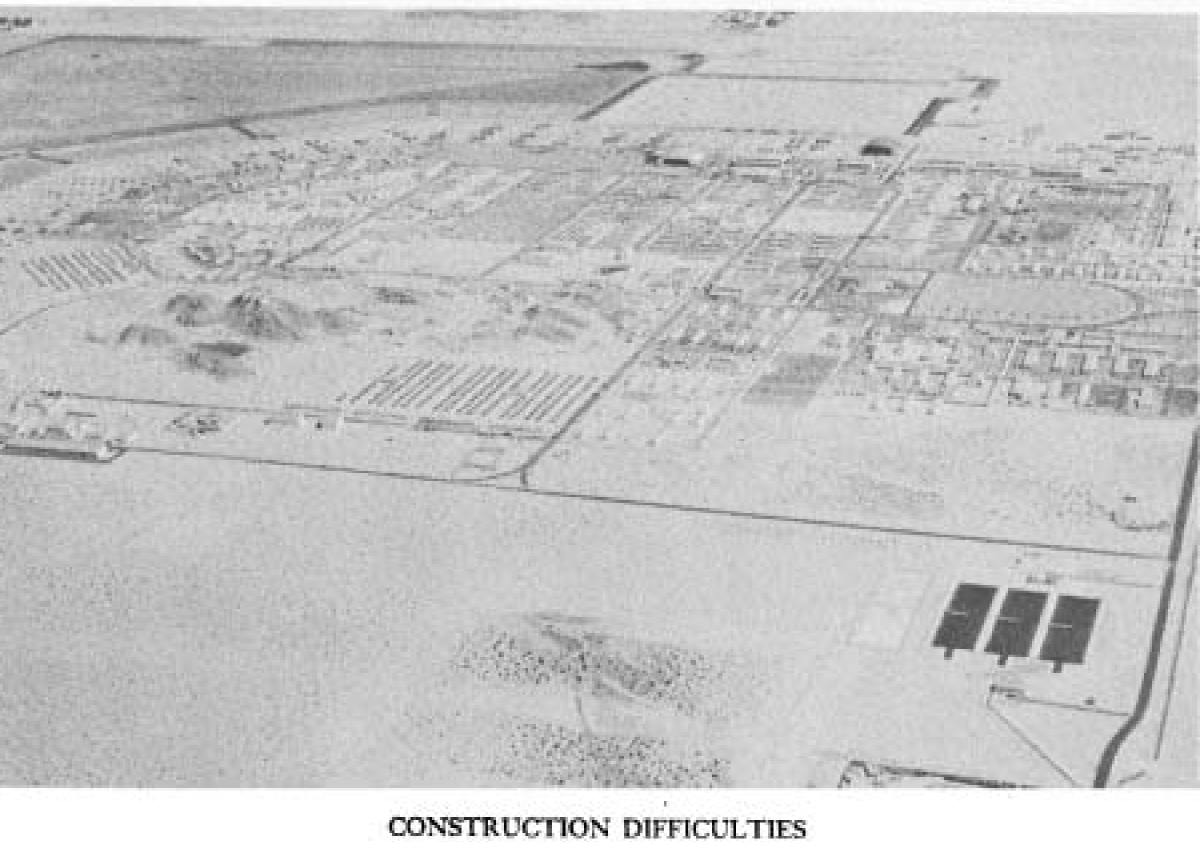


BARRACKS TYPES

Above: Permanent, March Field, Calif.

Center: Mobilization, Chanute Field, Ill.

Below: Theater of Operations, Marfa Army Air Field, Tex.



CONSTRUCTION DIFFICULTIES

Above: Mud at AAF Technical School, Sioux Falls, S.D.

Below: Sand at Yuma Army Air Field, Ariz.

stead Field at Middletown was so small and circumscribed by flying hazards that it was dangerous to land and take off.[16]

Army observation units, organically a part of the Air Corps but assigned to Army ground units for control, were located at Lawson Field, Fort Benning, Georgia; Pope Field, Fort Bragg, North Carolina; Godman Field, Fort Knox, Kentucky; Gray Field, Fort Lewis, Washington; Marshall Field, Fort Riley, Kansas; and Post Field, Fort Sill, Oklahoma. These units varied in size from a flight to a squadron, and the fields were usually small and limited in facilities. Godman, for example, had originally been the Fort Knox polo grounds, and the observation squadron stationed there operated from a grass strip. In October 1937 the housing at these fields had been described as ranging from "fair to bad." Other small Army fields were Sherman at Fort Leavenworth, Kansas; Stewart at West Point, New York; and Phillips at the Aberdeen, Maryland, ordnance proving ground. None of these fields was controlled by the Air Corps.[17]

The bombing and gunnery ranges available to the Air Corps were too few in number and small in size for the intensive training desired. In 1937 the GHQ Air Force had described the lack of available ranges as the "limiting factor" in its preparation for combat. Hamilton and Mitchel had no regular ranges. Langley used a range on Plum Tree Island, off the Virginia coast, but its use would be disputed with nearby Fort Eustis until September 1940. Selfridge had a gunnery camp at Oscoda, Michigan, suitable only for summer use. The ranges at Barksdale were located on the main post, and bombing and gunnery interfered with the traffic pattern at the landing field. In 1933 tactical units at March Field had begun to make use of a dry lake bed at Muroc, California, for bombing and gunnery, a fairly satisfactory arrangement except in wet weather. In 1936 the Air Corps Tactical School had secured the donation of 1,460 acres of land including a small airport at Valparaiso, Florida. This installation, called Eglin Field, was being used for experimental bombing and gunnery exercises. Largest of the bombing ranges was a 64,000-acre tract southwest of Lowry Field which had been donated by the city of Denver in 1938.[18]

To facilitate cross-country flights, the Air Corps also maintained small detachments of weather, communications, and service personnel at twenty-nine civil airports. Since it was obviously impossible for the Army to maintain during peace the number of fields which

would be needed for war, it looked to the civil airports of the nation for the additional bases which could be used in an emergency. In January 1939, however, the Civil Aeronautics Authority (CAA), after an extensive survey, reported that only a small fraction of the nation's airfields could be used by the Air Corps. Of a total of 1,907 civil airports, only 882 had refueling equipment, only 230 had adequate lighting equipment, and only 231 had hard-surfaced runways. No more than thirty-six civilian fields could be considered fully suited for military aviation. Between 1933 and 1939 the United States government had spent from relief funds $137,931,950, a sum larger than that expended for all Army airfields, on the development of civil airports, but most of this money had gone into small local fields which were of doubtful use to the military.[19]

Several explanations lie behind this story of inadequate facilities. The Air Corps had been penalized by the unavoidable necessity of depending heavily upon World War I bases during the postwar years. The Wilcox Act, it is true, had authorized badly needed installations, but the Air Corps had found it inexpedient to ask for more than one field, because, among other reasons, it would not have had the strength to man additional bases even if they could have been built. The War Department, moreover, had not been entirely free to determine its own program of construction for the Air Corps. It had lost more than it had gained by the 1935 exchange of facilities, and thereafter the bulk of new construction had to go into the development of bases to substitute for those lost to the Navy. Since all funds for land acquisition had come from general appropriations, the Air Corps had not thought it wise to acquire new bombing and gunnery ranges when its bases were still below standard. It was also true that the original construction of most Air Corps bases showed a marked failure to anticipate the operational needs of the future. The small and slow planes of the pre-1939 Air Corps had needed only limited airfield facilities, and consequently the larger part of construction funds had been spent on buildings and grounds, all too often without regard for opportunities subsequently to expand flying facilities. At Maxwell, for example, only $497,258 out of a total of $5,371,167 had been spent on the flying field. And, finally, though the Air Corps had obtained a large share of all Army construction funds in the late 1930's, the total appropriations for such purposes had not been sufficient even to meet the needs of the Air Corps alone.[20]

Augmentation of Facilities, 1939–40

On 13 January 1939, the day after President Roosevelt had requested Congress to vote $300,000,000 for the purchase of Army aircraft, General Arnold proposed to the War Department that $62,000,000 of this amount be spent for two new continental air bases, and one new air base each for Puerto Rico, Panama, and Alaska. His proposal, he urged, would provide the foundation for "a well-rounded air defense which would be wholly lacking if the whole $300,000,000 were devoted to the procurement of airplanes."[21] At that time he hoped to secure an additional $20,000,000 from the Works Progress Administration for the construction of two new air depots, a hope destined for disappointment. But the disappointment mattered little. By summer Congress had voted a cash outlay of $64,862,500 for Air Corps construction and had authorized the obligation of $21,337,500 in contracts.[22]

Determined to stretch these funds as far as possible toward meeting the indispensable needs of an expanding Air Corps, Arnold warned all station commanders against attempts to bring pressure on the War Department through civilian channels for pet projects of their own. Funds could be made available for "only the most urgently needed essential items."[23] Permanent brick-and-concrete-type construction would be used only for technical buildings in the United States. Troops would be housed in temporary mobilization-type wooden structures. General Arnold was certain that nothing had been left in his construction program "but the mere flesh and bone."[24]

In 1939 War Department construction procedures were slow and deliberate. Ordinarily, the using service indicated its general needs and, if new stations were to be built, requested the appointment of War Department site boards to recommend locations for them. The Assistant Chief of Staff, G-4, initiated the necessary papers, and after approval by the Chief of Staff, the boards, whose membership represented all interested agencies, were formally appointed by The Adjutant General. After investigation, these boards reported to The Adjutant General, who routed the reports to the General Staff's G-3 and G-4 and to the chief of the using service for comment. The Secretary of War gave final approval of the new sites. Following this, the using service requested the initiation of construction, and G-4, acting for the Chief of Staff, directed the Quartermaster General to acquire the necessary real estate and to prepare plans in coordination

with the using agency. Approval of the plans having been secured, construction directives were prepared by G-4, approved by the Chief of Staff, and issued to the Quartermaster General, whose construction officers at the local projects supervised land acquisition and actual work at the sites. Within the OCAC the responsibility for recommending sites rested largely with the Plans Section, and the Buildings and Grounds Section reviewed all layout plans for new construction.[25] This leisurely procedure would be much changed by the impact of the war emergency, but it was slavishly followed in 1939.

Planning for the location of the new facilities had actually begun long before the appropriations for their construction. In 1936 the Air Corps Board had recommended that new combat bases should be far enough inland so that enemy aircraft would have to search for them over unfamiliar territory. With this principle in mind, in October 1938, the War Department, acting on General Arnold's request, had established a site board, composed of representatives of the General Staff and the OCAC, and had directed it to locate an air base in the northeast. In January 1939 the board was further instructed to pick a site for an air base and another for an air depot, both of them in the southeast. None of the sites subsequently recommended by the board in April was found acceptable, but an agreement was soon reached on the locations for the southeast air base and air depot. On 13 July the Secretary of War announced that they would be located, respectively, at Tampa, Florida, and at Mobile, Alabama. The Tampa site was thought desirable because it was far enough south to permit aircraft to operate in the Caribbean and still to be shielded by the mainland of Florida against carrier-borne air attacks. The site for the air depot at Mobile would make it suitable both for providing maintenance in the southeastern United States and for potential support of the Caribbean area.[26] Location of the northeast air base at a site near Chicopee Falls, Massachusetts, a decision made difficult by the dense population of New England, was not announced until 15 September 1939.[27] Selection of a site for the Rocky Mountains air depot had been settled much earlier. In the period of optimism following the passage of the Wilcox Act, a site had been selected adjacent to the ordnance depot at Ogden, Utah, options had quietly been taken on land, and the Air Corps had arranged for getting WPA assistance in developing an airfield, ostensibly for the ordnance depot. In the discussions of the appropriation bill, the Army had committed itself to the Ogden site,

which it considered suitable for supplying any place on the Pacific coast and yet far enough distant to protect it from enemy air attack.[28]

Some time was lost in drawing up plans and clearing the titles to the land for these new stations, and construction could not begin at any of them before January 1940. General Arnold privately estimated that the air bases would not be operational for at least two years, and his predictions proved only slightly overpessimistic.[29] MacDill Field, the southeast air base, received its heavy bombardment group in May 1940, but it had to use the airport at Tampa's Drew Field until February 1941. Because the maintenance buildings were unheated, the heavy group scheduled for Westover Field, the northeast air base, could not be transferred there until May 1941. The Ogden Air Depot and its adjoining Hill Field were completed late in 1941, but the Mobile Air Depot and its Brookley Field were not ready for full-scale operations until January 1942.[30]

The augmentation program included no appropriations for new flying training fields, but the Chief of Air Corps was allowed to enroll aviation cadets in nine civilian flying schools.* The government incurred no expense and no responsibility for the erection of facilities at these contract schools. The appropriations did include funds for the expansion of the plants at Chanute and Lowry. In addition, the Air Corps Technical School secured the use of Scott Field, effective 1 June 1939, for housing a basic training center, and it was permitted to enroll students in seven civilian schools.[31]

Efforts to secure bombing and gunnery ranges during the 1939 expansion were only partly successful. In September the OCAC requested funds for a range at Valparaiso, Florida, and for others at Hamilton and McChord Fields. Money was appropriated for the latter two ranges in February 1940, and in June the whole Choctawhatchee National Forest at Valparaiso was transferred to the Army, together with money to begin clearing the civilian holdings within the reservation.[32] Two site boards, representing the General Staff, the OCAC, the GHQ Air Force, and the Quartermaster Corps, were sent out to locate ranges. The board which was to have located sites in the eastern United States suspended its activities when the Choctawhatchee Forest was transferred to the Army, but before concluding its work in April 1940 the western board located possible sites near Arlington, Washington; Sacramento, California; Wendover, Utah; and Tonopah,

* See below, pp. 455–56.

Nevada. The Air Corps secured almost immediate possession of a tract of waste land near old Mather Field at Sacramento, but negotiations for the other ranges dragged on and became a part of the 1940–41 expansion of facilities.[33]

During 1939 the Chief of Air Corps worked with the CAA and WPA in an effort to build up civilian airports of value to the national defense. Faced with the beginning of the war in Europe, the OCAC almost immediately asked the WPA and CAA to improve all of the civil airports lying within 100 miles of the coast from Maine to Mobile, Alabama, in a first-priority effort. As a second priority, it asked that WPA funds be spent at the larger inland airports. In talks between representatives of the three agencies later in September, however, it developed that by law WPA funds could be used only according to the relief needs of the states and that each municipality had to contribute a sponsor's share of funds in order to secure a WPA grant. The WPA nevertheless offered to keep the sponsorship share as low as possible at deserving projects, the CAA agreed to solicit sponsors for fields having military importance, and the OCAC agreed to designate such fields. After consultations between the War Department's War Plans Division, the Navy, and the OCAC, such a list of fields was forwarded to the WPA early in January 1940.[34] Most of these fields were located in the four defense areas of the United States, and nearly all of them would be brought into military use after Pearl Harbor.

Expansion of Facilities for Hemispheric Defense, 1940–41

By April 1940 the augmentation program conceived before the beginning of World War II had brought the Air Corps up to a personnel strength needed to man its authorized twenty-five combat groups.[35] The major airdromes required to defend the United States were under construction, and arrangements had been made to build up civilian fields needed for dispersal against attack. Continued Nazi successes, however, made it almost immediately evident that twenty-five groups could not successfully defend the Western Hemisphere. In the Army appropriation for fiscal year 1941, approved on 13 June, Congress voted funds to complete the construction authorized in 1939, to expand the enlisted strength of the Air Corps to about 55,000, to increase the number of aircraft authorized, and to raise pilot train-

ing to 7,000 per annum. In a supplemental appropriation, spurred to quick approval on 26 June by the collapse of France, Congress voted funds to increase the Air Corps enlisted strength to approximately 94,443 men.[36] Following a directive of 29 June, the OCAC submitted plans for 54 combat groups, 6 transport groups, and 4,006 tactical aircraft assigned to units.[37] Funds and personnel, however, permitted the immediate organization of only forty-one combat groups, and it was not until 8 October 1940 that Congress appropriated money for the others.[38] Both programs were, with the exception of their accompanying pilot expansions, undertaken simultaneously under the designation of the Army's First Aviation Objective. Expansion of the combat strength would require increases in the flying training rate first to 7,000 pilots annually for the 41-group strength and then to 12,000 pilots a year for the 54-group strength. The 41-group program would require an Air Corps enlisted strength of over 94,000, and the 54-group project would need more than 136,000.[39] The Technical School would have to increase its training rate so as to provide 52,000 enlisted technicians by the end of 1941. Three new air depots would be needed to take care of the increased number of Army aircraft. Finally, new stations would be needed for the additional combat groups to be formed.

Although no definite time limit was established for the accomplishment of the First Aviation Objective, the steadily deteriorating Allied cause in Europe admitted no delay. The program could not wait for the completion of new air bases such as MacDill and Westover, and the War Department accordingly announced that existing facilities—military, state, and municipal—must be used to the maximum. All new construction would be of a temporary wooden type, and the number of hangars and maintenance buildings would be kept to a minimum.[40] All agreed that site-selection and construction procedure had to be simplified, but there was difficulty in finding a workable one. In November 1940 the Quartermaster Corps, overburdened by the immensity of Army construction, transferred all Air Corps construction to the Corps of Engineers.*

The most immediate task in June 1940 was to increase the pilot-training rate to 7,000 annually. On 24 May, General Arnold had submitted a plan to the War Department proposing to establish three flying training centers, to be designated the Southeast, Gulf Coast, and

* See below, p. 135.

West Coast Air Corps Training Centers. To the first of these would be assigned Maxwell, Barksdale, a new station to be near Maxwell, and a new gunnery school at Eglin Field. The second was to control Randolph, Kelly, Brooks, and two new stations in Texas. The third would take over Moffett and was to open a new station in California. Each of the nine civil primary schools was to open a new school south of the 37th parallel, where flying conditions were most suitable. The War Department approved the plan in principle on 6 June, and a week later Congress appropriated funds to carry it out.[41] The Air Corps Training Center, acting on War Department orders, appointed a site board to select the locations for the new stations. This group met in Washington on 13 June and, after a somewhat perfunctory investigation, recommended that the new stations be located at the Montgomery, Alabama, and Stockton, California, municipal airports, at the site of old Ellington Field near Houston, Texas, and at a new site to be leased at San Angelo, Texas. Later in the month another school site, seemingly not originally contemplated, was selected near Selma, Alabama.[42]

With these preliminaries out of the way, the redistribution of existing facilities was undertaken. The new centers were established in July, and by October the older stations had been assigned according to Arnold's plan.[43] Originally, the OCAC had intended that all of the new training fields would have only grass landing surfaces, but soil conditions at the sites chosen soon made it evident that heavy training would make paved runways or landing mats essential. The two municipal fields—Gunter Field at Montgomery and the Stockton airport—did not require such additions and were ready for use during November and December 1940. All of the other stations, except Ellington, were ready to begin training during the spring of 1941.[44] At Ellington work bogged down in unusually wet weather and was not completed until fall.

To accomplish the training of approximately 52,000 technicians before the end of 1941, the OCAC estimated that at least two additional Army technical schools would be required.[45] The Technical School, however, opposed the idea, on the grounds that neither trained personnel nor equipment could be made available for new schools. The OCAC secured funds from Congress for the two new schools, but they were not actually started as a part of the First Aviation Objective. Instead, the Air Corps took possession of the old Army post at Jefferson Barracks, St. Louis, Missouri, on 30 July and moved its

basic training center there. Scott, thus released for other duties, became the permanent station for radio training in September. To clear Lowry for armament and photographic training expansion, the Air Corps secured Fort Logan, Colorado, and moved its clerical course there in March 1941. Through staggering shifts at existing schools and farming out other students to eight additional civil schools the Technical School succeeded in fulfilling its training responsibility.[46]

At the same time that it was making plans to expand its training facilities, the OCAC was studying the more difficult problem of securing stations for the new tactical groups. The 54-group program would more than double the number of combat groups assigned to the GHQ Air Force; its four existing combat wings were to be increased to seventeen, and four new air districts (redesignated as air forces in the spring of 1941) were to be formed. But the most immediate task was to find stations for the combat groups which had to be moved out of Moffett, Maxwell, and Barksdale. After several plans had been offered, the War Department finally approved the proposal to move the heavy bombardment group from Hamilton to the municipal airport at Salt Lake City, Utah, and to replace it with the fighter groups from Moffett. At Salt Lake City the bombardment group would be housed initially at Fort Douglas, another old Army post which was being given up by the ground troops. The composite group at Maxwell would be moved to the municipal airport at Orlando, Florida, and the Air Corps Tactical School would be temporarily inactivated.[47] During July 1940 leases were negotiated for building areas adjacent to these two municipal fields, and shortly afterwards the Quartermaster Corps began the construction of cantonments. Most of the moving was done during September.[48] In early October the light bombardment groups from Barksdale were moved to a leasehold at Savannah, Georgia, where they occupied tent camps until a cantonment could be built.[49]

Since few of the other municipal airports of the nation were suitable for the use of combat groups, the OCAC supported proposed legislation which would appropriate funds to the CAA for the development of a national system of airfields suitable for defense purposes.[50] In October 1940 this legislation was enacted, giving the CAA $40,000,000 with which it was directed to improve not more than 250 airports designated by the War and Navy Departments as important to national defense.[51] By December a list of these airports had been worked out in joint conferences, and by March 1941 the last of

the CAA's funds had been allocated.[52] To carry on this essential work, Congress appropriated another $94,977,750 to the CAA in June 1941 and raised the number of airports which could be improved to 399.[53] In the expenditure of these funds the OCAC sought to get CAA to build up the airports at which its combat groups were to be based, to develop other fields in each of the nation's four defense areas, to improve fields needed for ferrying, and to build new airports to accommodate civilian flying displaced from airports leased for military use.[54]

Selection of sites for the new stations required under the 54-group activation schedules began in June 1940. The Plans Division, OCAC drew up a tentative list of municipal fields considered suitable for military use and submitted it to General Arnold on 15 June. It also recommended that a board of officers representing the GHQ Air Force, the Buildings and Grounds Division, OCAC and the Training and Operations Division, OCAC be appointed and sent out at once to begin an investigation of sites. By 2 July a revised list of suggested sites had been submitted by the OCAC to the War Department.[55] But the General Staff was unwilling to detail such a board as the Plans Division had suggested. Instead, the boards appointed on 18 July represented the General Staff, the GHQ Air Force, and the Quartermaster General.[56] The G-4 issued the general instructions to the three boards, and although they were permitted direct communication with the Chief of Air Corps, they were instructed to report directly to The Adjutant General.[57]

Both their constitution and their lack of definite instructions led the boards into numerous difficulties. None of the board presidents was an Air Corps officer and, according to the GHQ Air Force representative on one of the boards, the president had to be "merely a puzzled and confused figure-head" or else he had to assume an active role which was likely to cause personality clashes. The boards were seemingly uncertain about just what concessions they should try to get from a local community, and bidding for Air Corps bases by each municipality contacted appears to have been more encouraged than discouraged. Lack of instructions led to inconclusive reports that a certain site would be satisfactory "if and when so and so" was accomplished by the city.[58] Slowness of the boards in making their final reports caused the G-4 to direct early in August that each of them give tentative yes-or-no answers by telephone as soon as they had inspected a new site.[59] Because of this delay, a general conference held on 17 August, attended by both General Marshall and General

Arnold, undertook to draw up a tentative list of the new stations without the benefit of all of the formal site board reports. The list was somewhat modified as additional information came in. Although the Plans Division assigned construction priorities to twenty-four airport projects on 18 September, the whole list was not definitely established until December.* In the opinion of the OCAC Buildings and Grounds Division, the site boards had held up the whole program about two months.[60]

After each board report had been circulated and approved, the Quartermaster General was directed to start lease negotiations. Generally, the leases sought to limit civilian flying on the airfields being used by the military to scheduled airliners and to other privately owned aircraft equipped with two-way radio. Early in November, however, the OCAC discovered that few of the leases had contained provisions to restrict civilian student flying; other leases had failed to secure areas large enough for the Army cantonments. Renegotiation of the leases added to the delay in beginning the building effort.[61]

By November 1940 it was obvious that the Construction Division of the Quartermaster Corps was being overtaxed by its burden. At the same time, the Corps of Engineers, normally responsible for river and harbor construction projects, had less than its usual quota of work because of the shifting emphasis from civil to military projects. Seeking to speed up the lagging Air Corps program, the G-4 accordingly proposed early in November that all Air Corps construction be transferred to the Corps of Engineers for supervision and control. The Buildings and Grounds Division initially opposed the transfer since it feared additional delays, but General Marshall directed the change on 19 November 1940. The transfer of responsibility for stations already under construction was made gradually during the next three months, seemingly without causing any additional delay. The Corps of Engineers made no immediate changes in administrative procedure, but merely replaced the Quartermaster Corps in all that had to do with Air Corps construction.[62]

* The stations finally used in the 54-group expansion were Salt Lake City, Utah; Orlando, Fla.; Drew Field, Tampa, Fla.; Dale Mabry Field, Tallahassee, Fla.; Hunter Field, Savannah, Ga.; Bowman Field, Louisville, Ky.; Morrison Field, West Palm Beach, Fla.; New Orleans, La.; Davis–Monthan Field, Tucson, Ariz.; Kirtland Field, Albuquerque, N.M.; Portland, Ore.; Will Rogers Field, Oklahoma City, Okla.; Grenier Field, Manchester, N.H.; Key Field, Meridian, Miss.; Paine Field, Everett, Wash.; Geiger Field, Spokane, Wash.; Hammer Field, Fresno, Calif.; Morris Field, Charlotte, N.C.; Daniel Field, Augusta, Ga.; Gowen Field, Boise, Idaho; Harding Field, Baton Rouge, La.; Pendleton, Ore.; and Bradley Field, Windsor Locks, Conn.

The difficulties which had beset the program were by no means ended once construction got under way. Because it was impossible to make accurate plans without knowing where the stations would be, the cost estimates for the construction had been, as the Buildings and Grounds Division later admitted, no more than a "shot in the dark."[63] Consequently, on 17 March 1941 Congress had to appropriate additional funds for the work. Although achievements were notable, so were the failures. Hunter Field at Savannah, Georgia, was given a cantonment in ninety working days through expedited cost-plus-fixed-fee contracts.[64] Other stations were built in a very short time, and the activation program of the Air Corps was not materially delayed by the building effort. Most of the failures seem to have been due to the derelictions of the site boards. At New Orleans, Louisiana, the municipal airport, enthusiastically recommended as a station for a heavy bombardment group, proved to have excessively short runways when the group moved into the new post. Daniel Field at Augusta, Georgia, turned out to be too small for any type of tactical group. Before work had actually begun, the municipal airports at Fresno, California, and Fort Wayne, Indiana, were found to be unsuited for military use, and the Air Corps projects had to be transferred to new fields being built by the CAA in the same areas.[65] Nor were the commitments obtained by the site boards from the municipalities always an unmixed blessing. At Bangor, Maine, the city authorities at first contracted to maintain the runways at Dow Field, but when they realized that Army aircraft would be the heaviest users of the field, they refused to carry out their part of the lease. The Air Corps recognized that it was unfair to expect the city to keep up the airfield, and the government finally had to buy it in order to assume such functions.[66] Although some of the fields selected proved to be unsuited for their planned purposes, the Air Corps in its following expansions nevertheless made full use of them.

As the GHQ Air Force occupied the new stations, it began to encounter operational hazards caused by unskilled civilian flying. To meet that organization's emphatic complaints on this score and to seek some solution for the growing problems of congested air traffic in many areas, the War Department sponsored the formation of an Interdepartmental Air Traffic Control Board with representation from the Air Corps, the Navy, and the CAA. Although this board, established in April 1941, was able to find no immediate solution to its main problem, it nevertheless became an important coordinating agency for

the location of Army and Navy air installations.[67] Because of traffic hazards the Air Corps had decided that it could use no more municipal fields unless they could be leased in their entirety.[68]

Facilities also had to be provided for the headquarters of the GHQ Air Force, the new air districts, the new commands, and the new wings. The GHQ Air Force headquarters was moved from Langley to Bolling in March 1941. Wing headquarters were located on tactical air bases. Notwithstanding Air Corps policy enjoining separate headquarters stations for air districts and commands, the headquarters of the Northeast Air District (First Air Force) was located at Mitchel, supposedly as a temporary measure. That of the Southeast Air District (Third Air Force) was established in the National Guard armory in Tampa, Florida, that of the Southwest Air District (Fourth Air Force) in leased space in Riverside, California, and that of the Northwest Air District (Second Air Force) at Fort George Wright, Spokane, Washington. The headquarters of the I and IV Interceptor Commands were located with their parent air forces, but those of the II and III Interceptor Commands were at Fort Lawton, Seattle, Washington, and Drew Field, Tampa, Florida.[69]

For the 12,000-pilot (54-group) program the OCAC had first estimated that eight new flying training fields, two new gunnery stations, and five new cadet reception centers would be needed. Funds for their construction were appropriated on 24 September 1940. Later that month the OCAC directed each training center to designate boards to locate potential sites, and by December each center had recommended its quota. To make the selections official, the War Department appointed a board of officers, representing the Buildings and Grounds Division, the Training and Operations Division, and the Chief of Engineers, which inspected the recommended sites. By early March 1941 the War Department had accepted the sites for the seven flying training stations which were to be built and for the two gunnery stations.* Belated opposition arose later in the month when the GHQ Air Force protested against the location of additional training

* Arranged by training center, the new flying training stations for the 12,000-pilot program were:

Gulf Coast Training Center—Foster Field, Victoria, Tex.

West Coast Training Center—Minter Field, Bakersfield, Calif.; Mather Field, Sacramento, Calif.; Luke Field, Phoenix, Ariz.; and Gardner Field, Taft, Calif.

Southeast Training Center—Cochran Field, Macon, Ga., and Turner Field, Albany, Ga.

The additional gunnery schools were at Las Vegas, Nev., and Tyndall Field, Panama City, Fla.

fields near the Pacific coast, but the OCAC, unwilling to deprive training organizations of the favorable weather there, overruled the protest.[70] Most of the flying training stations were ready for use in June 1941, but difficulties in securing gunnery ranges held up the operation of the gunnery schools until shortly after Pearl Harbor. Only three of the five reception centers originally projected were opened: one at Maxwell in September 1941, one at Kelly in November 1941, and one at Santa Ana, California, in February 1942.[71] Eleven new civil contract schools for primary flight training were established.*

Three new depots had to be added under the First Aviation Objective. The four original ones had a combined capacity for overhauling 800 engines a month, and Mobile and Ogden were expected to be able to overhaul an additional 500 a month; but the Materiel Division, OCAC estimated that over-all requirements would attain 20,000 engines annually. The OCAC, taking into consideration the frequent incompatibilty of theoretical and actual performance, asked for the additional depots to be built with a combined monthly capacity of 900 engines, and Congress appropriated $45,000,000 for the purpose on 17 March 1941.[72] The OCAC came to a quick agreement with G-4 and the Chief of Engineers in regard to the designation of site boards. The Chief of Air Corps would, with War Department orders, establish the boards, instruct them, and receive their reports which, however, would be reviewed by the G-3 and G-4 before approval. By April sites had been selected near Oklahoma City, Oklahoma; Rome, New York; and Macon, Georgia. None of them was without disadvantages, but each was in an area of anticipated need and the three cities offered desirable concessions to get the depots. All of them were ready for operation by the fall of 1942.[73] The facilities required by the First Aviation Objective had hardly been programmed before new organizations became necessary under the Army's Second Aviation Objective. On 14 February 1941 General Marshall directed the Chief of Air Corps to increase pilot training to a rate of 30,000 a year and to raise the annual goal for technician training to 100,000 men. On 14 March the War Department set the Air Corps' objective at 84 combat groups, to which 7,799 aircraft would be assigned.[74]

Planning for the new expansion again had preceded the issuance of a formal directive. The OCAC at first intended to use the same site-

* See below, p. 457.

selection procedure as had been used for the 12,000-pilot program, but in March 1941 a conference between representatives of G-4, the Chief of Engineers, and the Buildings and Grounds Division agreed that in the interests of efficiency and speed site selection should be delegated to the three training centers, each of which would be required to name a board composed of an Air Corps, a Medical Corps, and a Corps of Engineers officer. Their reports would go to the Chief of Air Corps for review and then to the General Staff for final action. The Chief of Engineers indicated that his representative would be the local district engineer in the area being investigated.[75] Funds for twenty new flying training fields, one new gunnery station, and one new reception center were voted on 5 April 1941. The Air Corps also now had to find substitute facilities for Moffett Field, which the Navy desired to repossess for use as a lighter-than-air patrol base. After extended negotiations, the OCAC agreed to surrender the base for $6,500,000.[76]

Problems of site selection in each of the centers were peculiar to their geographical areas, but each found that acceptable sites for training fields were becoming scarce. In the West Coast Training Center the situation became especially acute, and by June 1941 there seemed to be no alternative but to locate the new stations in more northerly regions of excessive rainfall or the southwestern desert country where heat, dust, and insufficient civilian housing would be encountered. Partly to alleviate this threatened difficulty, the OCAC extended the center's eastern boundary from the 108th to the 103d meridian, permitting it to enter the mesa country of New Mexico and west Texas. Despite such difficulties, however, all of the new stations had been placed before the end of the summer,* and contracts had been made with sixteen additional primary schools.[77] Although the War Department, realizing that sites which could be leased for nominal rentals were not always the best bargains, had authorized

* The flying training stations for the 30,000-pilot program were:

Gulf Coast Training Center–Enid, Okla.; Perrin Field, Sherman, Tex.; Waco, Tex.; Moore Field, Mission, Tex.; Lubbock, Tex.; Midland, Tex.; and Lake Charles, La.

West Coast Training Center–Lemoore, Merced, Chico, and Victorville, Calif.; Roswell, N.M.; and Williams Field, Chandler, Ariz.

Southeast Training Center–Greenville and Columbus, Miss.; Hendricks Field, Sebring, Fla.; Shaw Field, Sumter, S.C.; Spence Field, Moultrie, Ga.; Napier Field, Dothan, Ala.; Moody Field, Valdosta, Ga.; and Tuskegee, Ala.

The gunnery school was located at Harlingen, Tex., and the cadet reception center at Ellington Field, Houston, Tex.

the purchase of real estate for the new fields, most of the sites were leased in the usual manner. Only a few of the new stations were ready for training prior to Pearl Harbor, but most of them were brought into operation early in 1942 and all of them were complete by June of that year.[78]

The Technical Training Command, activated on 26 March 1941, accomplished most of its base expansion before Pearl Harbor. In the First Aviation Objective the Air Corps had been allotted funds for two new mechanics schools, but the money had not been spent, and late in 1940 the OCAC directed the Technical School to recommend sites for them. After visiting a large number of interested cities, the commandant of the Technical School recommended sites near Biloxi, Mississippi, and Wichita Falls, Texas. After further inspection by a War Department board, both were approved in February 1941. Necessary real estate was leased, the CAA allocated funds to improve both municipal fields, and by late September 1941 Keesler Field at Biloxi and Sheppard Field at Wichita Falls were ready to begin training mechanics.[79] In May 1941 funds were allotted to build an airfield, later called Buckley Field, on Lowry's bombing range near Denver. Scott and Chanute received additional housing and school buildings. In order to relieve the overcrowding at its basic training center at Jefferson Barracks, the OCAC requested additional housing for Keesler and Sheppard Fields, and by September both of the new basic training centers were ready to receive troops. Because of congestion at Chanute, the new headquarters of the Technical Training Command was moved to leased office space in Tulsa, Oklahoma, during September 1941.[80]

To maintain the new planes of the 30,000-pilot program, the OCAC asked for funds to build two additional air depots, and such money was included in the general appropriation for the pilot-training expansion approved on 5 April 1941. By July the Materiel Division had calculated the needs of both the 30,000-pilot objective and of the 30 new combat groups to be formed, and it had decided that two depots, if properly located, could serve both expansions.[81] Late in June a site-selection board, including representatives of the new Air Corps Maintenance Command, the Buildings and Grounds Division, the district engineer concerned, and a Medical Corps officer, had located a site for one depot in San Bernardino County, California; in July it selected a site at Spokane, Washington, which would be far

enough from the Pacific to withstand attack, have better weather and access to eastern raw materials, and would be on the inland route to Alaska.[82] The Spokane depot was ready for full-scale operations in July 1943, but the San Bernardino installation, lacking a high defense priority, did not become fully operational until early 1944.[83]

In locating additional bases for combat groups under the Second Aviation Objective, the Air Corps for the first time in its history was to be in charge of the selection and development of its own stations. The Chief of Air Corps, in a memo for Marshall on 7 May 1941, proposed to locate sites for twenty-one combat groups in the United States by appointing four site boards, one for each air force, consisting of an Air Corps and Medical Corps representative from the air force, a member from the OCAC, a representative of the Chief of Engineers, and an officer representing the corps area concerned. The boards would get their instructions from the Chief of Air Corps and would report directly to him. General Marshall having approved the procedure, the boards were appointed on 11 July. Because the recent reorganization of the War Department exempted the AAF from corps area controls, no corps area representatives were included. The senior air officer on each board reported to the OCAC for instructions late in July, where he received detailed specifications as to requirements for each type of base. In recommending new sites the boards seem to have been informally directed to give due consideration to states which had no air bases.[84]

The preparatory work at Headquarters had been thorough, but it had also taken much time. The Buildings and Grounds Division and the Chief of Engineers, before having to make budget estimates, had hoped to have sufficient time after receipt of reports from the site boards to draft detailed cost estimates based on an actual engineering survey of the sites. But early in August the Buildings and Grounds Division had to go ahead with estimates, to arrive at a figure described by the division as "the same guess work as have been all previous estimates."[85] Actually, there were so many uncertainties about the number and types of groups that would be based in the United States that no exact cost planning was possible. Not until November was there a firm decision to build up enough continental bases to support fifty-five combat groups. By this time, hearings had begun on the appropriation legislation, in which the AAF committed itself to building fourteen new bases in the United States. It first asked for $379,-

804,238 to build eleven complete airfields, to add construction at fourteen other stations, and to accomplish other miscellaneous projects. The amount had been approved by the House and had gone to the Senate before Pearl Harbor, but with the beginning of hostilities the AAF secured an amendment to the legislation adding $390,000,000 to complete all the facilities needed by the Second Aviation Objective. The amount desired was appropriated on 17 December, together with $59,115,300 allotted to the CAA for the development of an additional 105 public airports.[86]

On 20 September the War Department transferred most of its responsibilities relating to the acquisition of real estate for construction of air facilities to the Chief of the AAF.[87] Under the new setup, the Buildings and Grounds Division prepared recommendations for final approval by Arnold,[88] who had approved the sites for all fourteen of the proposed stations by 1 January 1942. The AAF immediately requested the Chief of Engineers to acquire the real estate for seven stations, all of them planned as all-purpose bases for accommodation of any type of group. Formal construction directives were issued for the seven stations during January and early February.* With the proposed locations kept confidential until appropriations for the construction had been made, political interference by cities willing to make special concessions in order to get an air base was kept to a minimum. Construction was rushed and by the late summer of 1942 all of the bases were in use.[89]

Concurrently with the First and Second Aviation Objectives, the Air Corps and the AAF expanded bombing and gunnery range reservations. By June 1940 General Arnold had decided that combat units would need both local practice ranges and larger general ranges. Congress had appropriated money on 17 March for thirty local practice ranges, described as areas of about four square miles to be located near the using base, to meet the 54-combat-group-program needs. The OCAC had delegated the responsibility for securing these ranges to the GHQ Air Force and to its successor, the Air Force Combat Command.[90] Selection and acquisition of the general ranges, large areas designed for aerial gunnery and actual bombing practice, how-

* The first seven stations were located at Syracuse, N.Y.; Richmond, Va.; Walla Walla, Wash.; Greenville, S.C.; Columbus, Ohio (Lockbourne Army Air Base); Rapid City, S.D.; and Smyrna, Tenn. The second seven stations were placed at Sioux City, Iowa; Topeka, Kan.; Ft. Worth, Tex.; El Paso, Tex.; Santa Maria, Calif.; Pueblo, Colo.; and Reno, Nev.

ever, continued to remain the duty of the OCAC. In 1940 and 1941 it cleared up civilian titles in areas near Tonopah, Nevada; Boardman, Oregon; and Wendover, Utah. Most of the 4,298,605 acres in these three ranges were public domain, but since each had a scattered number of grazing, homestead, and mining claims which were particularly hard to assess and purchase, their use was delayed until late 1941. Three other general ranges (near Alamogordo, New Mexico; Avon Park, Florida; and Myrtle Beach, South Carolina) were acquired by the Air Corps late in 1941 and exploited in 1942.[91] Acquisition of ranges for flying training encountered similar delays. Despite opposition from sporting interests, however, the Air Corps secured ranges on Matagorda Island and the nearby Matagorda Peninsula, both on the south coast of Texas. A range for Tyndall Field, Panama City, Florida, was purchased after long legal proceedings had increased costs from an estimated $225,000 to $537,916. Particular trouble was met in locating ranges for Luke Field. Suitable public desert lands were available between Gila Bend and Ajo, Arizona, but stockmen who had leased the area held up its use until late December 1941, when the government finally secured a condemnation of the leaseholds.[92] The effects of these protracted delays seriously impeded preparation for air combat during 1941. Throughout most of this critical year, for example, the combat units of the Second and Fourth Air Forces had only the crowded range at Muroc Dry Lake, California, for all their bombing practice.[93]

The search for small air support fields which accompanied the fulfillment of the First and Second Aviation Objectives was not an integral part of either program, nor was it a major concern of the Air Corps. The OCAC limited its attention at first to the development of stations for the Army observation and reconnaissance squadrons. It sponsored the construction of an air support station at Salinas, California, which during the summer of 1941 was ready to receive the observation squadron displaced from Moffett and a new reconnaissance squadron. It also secured the development of a reconnaissance squadron station at the Atlanta, Georgia, municipal airport. An additional site was leased at De Ridder, Louisiana, and a small station was built to accommodate an observation squadron supporting the armored division training at Camp Polk, Leesville, Louisiana.[94] Since most of the new observation squadrons being mobilized were National Guard units that would train with ground divisions also being mus-

tered into federal service, the General Staff and the National Guard Bureau assumed the task of locating fields for all of the twenty-one squadrons inducted during the winter of 1940 and the early spring of 1941.[95] In the selection of stations for a second group of eight squadrons which were subsequently brought to active duty, the Chief of Air Corps participated only slightly. By April 1941 General Marshall had approved sites for the permanent stations of all of these National Guard squadrons;[96] many of the stations were leaseholds on municipal airports, where the first construction projects provided only the bare essentials for light airplanes and limited numbers of personnel. Esler Field at Alexandria, Louisiana, for example, in November 1940 used the abandoned buildings of a Civilian Conservation Corps camp, and its runway was reported unsafe in wet weather. Reilly Field at Fort McClellan, Alabama, was found to be unsafe for flying in any weather, and the Chief of Air Corps secured its abandonment before much work had been done. The tent area at Columbia, South Carolina, was located along the runway of the municipal field, and its occupants were prominently exposed to the public view. In June 1941 the Inspection Division, OCAC found the whole observation situation "extremely poor."[97] In an effort to bring some order into the training and use of these squadrons, General Marshall ordered the AAF to assume active control of them in July 1941, and in the ensuing reorganization they were divided into observation groups which were placed under five air support commands, responsible in turn to an Air Support Section of the Air Force Combat Command. By this reorganization the AAF assumed the basic responsibility for the development of their fields, but as late as the early spring of 1942 air force commanders still did not know whether they controlled the observation bases.[98]

Only one other Air Corps function required additional bases during the year preceding Pearl Harbor. This was the air transport and ferrying effort, which on 29 May 1941 was concentrated in a new Air Corps Ferrying Command. Since this command was initially designed to ferry British lend-lease aircraft from the factories to peripheral transfer points in the United States, lend-lease funds were to be used for needed base development, but the command was supposed to make the maximum use of existing Army and municipal airfields. By December 1941, however, it had secured a leasehold on the Wayne County Airport, Romulus, Michigan, and had purchased municipal

fields at Presque Isle and Houlton, Maine, for use as transfer points.[99]

By 7 December 1941 the AAF had developed 114 bases and sub-bases in the continental United States, and it had 47 other airfields projected or under construction. Counting the facilities provided for all of its various detachments of whatever nature, the AAF had a total of 293 separate installations either owned or leased. Additionally, the AAF had sponsored the development by the CAA of a number of other civilian airports which would be immediately suitable for military use. There had been difficulty and delay, but over the course of two years the work had been done with sufficient expedition to make possible the extraordinary expansion of all AAF activities that would follow hard upon Pearl Harbor.[100]

Expansion of AAF Facilities, 1942–43

The news from Pearl Harbor had a twofold effect upon the problem of AAF base installations. First and most pressing, the AAF had to take over new fields on which to disperse its units, both for their own protection against possible enemy attack and for the defense of the continental sea frontiers. Second, it had to provide the installations needed for the immediate mobilization of an air force of tremendously increased size. The beginning of the war thus brought about a quick multiplication of the number of AAF airfields, forced new attention to ways in which quicker and cheaper construction might be achieved, and shifted the scarce factor in construction from funds to labor and critical materials. The very immensity of the effort led to a decentralization in which using agencies in the field, not AAF Headquarters in Washington, had to assume the responsibility for determining the facilities they needed. Only as 1943 brought the double assurance of security from serious enemy attack and of base facilities equal to the demands of full mobilization would AAF Headquarters begin to reassume immediate control.

The news from Pearl Harbor and Clark Field pushed to the fore problems of passive defense—that is, of the need for revetments, dispersal, and camouflage as protective devices against possible air attacks. On 9 December, General Arnold directed that all aircraft west of the Rocky Mountains be dispersed immediately and that they be protected by revetments; on the Atlantic coast all large concentrations of planes were to be similarly protected. Within a few days it was decided that all new bases to be built within 350 miles of the

Atlantic and Pacific and within 300 miles of the Gulf would be given a dispersed layout.[101] The War Department was comparably prompt in extending, first to the Western Defense Command and then to the Eastern Theater of Operations, the power to bypass normal channels in getting emergency construction done.[102] By 26 December the Corps of Engineers had started eighty-one projects at airfields on the Pacific coast, including hardstandings, dispersal taxiways, revetments, and sandbag protective devices. Along the Atlantic coast fighter revetments were constructed at twenty-three bases, and heavy bomber dispersal areas were built at seven fields. Both for training and for camouflage, a complete dummy airdrome was built near the Richmond Army Air Base.[103] The excitement, however, soon passed. In February 1942 the War Department curtailed the emergency powers over construction formerly given the continental theaters of operations, and by March the construction of revetments was prohibited unless on special authorization. By the end of the year the AAF, with some overseas experience to guide it, had returned to more compact and conventional airfield designs. In March 1943 the War Department directed that in the future passive defense projects would be limited to vital zones and would be as simple as possible. In October 1943 General Arnold directed that no more such construction be approved for the AAF in the United States.[104]

The continental air forces had rushed their combat groups into a defensive deployment as quickly as possible after Pearl Harbor and had undertaken to develop the necessary subbases and auxiliary fields, chiefly through the development of civilian airports. First Air Force having deployed its pursuit units in accordance with a plan depending upon airfields at Norfolk, Virginia; Bendix, New Jersey; Philadelphia, Pennsylvania; Farmingdale, New York; Baltimore, Maryland; Groton, Connecticut; Bridgeport, Connecticut; and Boston, Massachusetts, the Eastern Theater of Operations in January 1942 ordered emergency projects to prepare all of those airfields for military occupation.[105] As the year progressed, there was some recovery from the pressure for "a fighter base every five miles," but by May 1943 the First Air Force had developed twenty-two defense fields in its operational area.[106] Most of the fields had facilities for only a single fighter squadron, althought those at Millville, New Jersey; Westhampton Beach, New York; and Andrews Field, Camp Springs, Maryland, were larger installations.[107] In addition to these pursuit fields, the First Air Force

also had to provide fields for its I Bomber Command, charged with antisubmarine patrol off the Atlantic and Gulf coasts. Such stations were built at Dover, Delaware, and Bluethenthal Field, Wilmington, North Carolina, but for the most part I Bomber Command and its successor, the Antisubmarine Command, operated from the existing bases. Such of these bases as lacked heavy bomber facilities were built up for the antisubmarine units.[108]

The Third Air Force met its limited defense requirements without any additional fields. In March 1942, however, the AAF Directorate of Air Defense, calling attention to the need for pursuit fields to cover the Sault Ste Marie Canals, directed the Third Air Force to locate sites for such fields in northern Michigan. Although the area was primarily a gun-defended zone under the Central Defense Command, the AAF developed runways, lighting, and gasoline storage at Raco and Kinross, Michigan, against the possibility that they might be needed to protect the critical connection between the iron-ore fields on Lake Superior and the Great Lakes waterways.[109]

In the Pacific Northwest the Second Air Force, despite the fact that its plans were complicated by the impending transfer of the whole defense mission on the west coast to the Fourth Air Force,* moved a pursuit group to Seattle, Washington, and made plans to build up subbases and auxiliary fields. To the south, in California, the Fourth Air Force moved tactical units to the North Island Naval Air Station at San Diego, and to the municipal airports at San Bernardino, Long Beach, Bakersfield, Oakland, Sacramento, and to Mines Field at Los Angeles; and to facilitate coordination with the Western Defense Command, it moved its headquarters and that of IV Bomber Command to San Francisco early in January. The IV Interceptor Command headquarters remained temporarily at Riverside but moved to Oakland as quickly as it could establish communications facilities there.[110] By May 1943 it had acquired fifty-one subbases and auxiliary fields in Washington, Oregon, and California.[111]

Most of these fields taken over for defense had been built or improved by the CAA, and with the beginning of hostilities the continental air forces swamped the administration with requests for new work. By April 1942 these air forces had asked for improvements to about 600 airfields; the First Air Force alone had a list of 155 fields which it wanted developed. The problem was taken to General

* See above, p. 92.

Arnold on 27 April, and he, believing that the war would be fought in Europe and in the Pacific rather than in the United States, declared himself flatly opposed to the development of more than about a fourth of such a number of fields by the CAA.[112] In July 1942 the CAA received an appropriation of $199,740,000 and the ceiling on the number of the airports which could be improved was raised to 668, but this was to be the last substantial sum voted for such purposes during World War II. By the end of 1943 nearly all of the CAA projects had been completed.[113]

At the same time that it was effecting this expansion of facilities for the protection of the continental sea frontiers, the AAF was busy with the much greater problem of finding and developing other fields to accommodate the programmed expansion of its combat strength. In December 1941 the AAF announced that its immediate objective during 1942 would be to complete the 84-group program. Early in January 1942, however, it proposed to bring its strength up to 115 combat groups during 1942, to expand its pilot output first to 50,000 and then to 70,000 annually, and to increase its technician-training rate to 300,000 during the year. This program was approved by the War Department on 19 February. Programming for 1943 began at once, and during February 1942 the AAF set up for planning purposes a figure of 224 combat groups, a commitment approved in the War Department troop basis issued in August. At that time the AAF already had drawn up still more ambitious plans for an ultimate strength of 273 combat groups, a number which Arnold came by mid-December to regard as the "saturation-point" of Army air power. Although the composition of the program was thereafter revised four times, the total of 273 groups was not again changed during World War II.[114]

It was contemplated that no more than one-third of the combat strength of the AAF would be based in the continental United States at any one time. But each combat group so accommodated was to have one main base and four subbases, and additional installations would be needed for flying and technical training or for maintenance, repair, and storage.[115] Since the 273-group program was scheduled for completion by December 1943, its combat base facilities would have to be prepared before that time. Although the AAF wished to avoid the construction of "ghost villages" awaiting occupants, it was

deemed advisable to gear its building program at once to maximum requirements and to push it with all possible speed. In November 1942 all air forces and commands were instructed to submit full building projects, "ruthlessly pruned to the bare essentials" but equal to the demands of the 273-group program.[116]

The new facilities were to be provided subject to rules of "Spartan simplicity" laid down at the outset of hostilities. As Arnold explained the policy to his A-4 in January 1942, "all frills and non-essential items would be eliminated and only the bare essentials would be approved."[117] On 4 February the War Department directed that all buildings constructed should be of a theater-of-operations type, i.e., one-story, tar-paper structures, which were both cheap and easy to build. At Spokane, Washington, for example, it was estimated that housing for one man in theater-of-operations barracks would cost $44 instead of the $175 in the mobilization-type (two-story wooden) barracks formerly used. The new-type housing, moreover, could be built in one-sixth the time required for mobilization-type buildings.[118] On 20 May the Secretaries of War and of the Navy and the chairman of the War Production Board agreed that no construction project would be approved unless it was essential, could not be postponed without hurting the war effort, could not be replaced by rented facilities, represented all possible economies, and was of the most simple construction possible.[119]

Under the War Department reorganization of 9 March 1942, the Chief of Engineers, of the Services of Supply (later, Army Service Forces), was directly responsible for all Army construction and for acquisition of necessary real estate. But the AAF determined the operational characteristics of its own installations and controlled the expenditure of funds allotted to it. Plans and directives were submitted by the AAF to the Corps of Engineers through the Services of Supply, which was also responsible for the preparation of budget requests for necessary funds.[120] Within the AAF, the responsibilities for base facilities formerly belonging to the Air Force Combat Command and the OCAC Buildings and Grounds Division were now absorbed, on the operating staff level, by the Director of Military Requirements, whose office contained a Directorate of Base Services. On the policy-making staff the problem of base facilities fell to A-4. When the AAF dropped the distinction between policy and operating

staffs in March 1943, the Directorate of Base Services was transferred to the new AC/AS, Materiel, Maintenance, and Distribution. There, as the Air Installations Division, it continued to supervise the construction of base facilities during World War II.[121]

In April 1942 the AAF invested the commanders of its air forces and independent commands with responsibility for site selection, and on 23 July, pursuant to an agreement with the AAF, the Chief of Engineers authorized his division engineers to approve and construct projects costing not more than $40,000 when such projects were requested by the AAF commanders.[122] Such decentralization of authority made some safeguards necessary. Accordingly, the Director of Military Requirements enunciated an ironclad policy that all new sites would have to be approved by the Interdepartmental Air Traffic Control Board prior to acquisition, and the Directorate of Base Services demanded notification of intended acquisitions and information copies of all layout plans. In September 1942 the Directorate of Base Services sent liaison officers to work with each division engineer in order to insure that all new plans complied with AAF safety regulations.[123]

In the new expansion, as with earlier programs, the highest priority tended to go to the training plant. The Air Corps Flying Training Command, established on 23 January 1942, had a responsibility for construction comparable to that of the four continental air forces,[124] but it left the job of selecting sites to its three training centers. Each of these centers faced differing problems, but all encountered competition for desirable sites, all met miscellaneous pressures from political agencies, and all were hard-put to get their new facilities into operation as quickly as desired. Each of them was also forced to move into areas of marginal flying weather to avoid air space congestion. The Southeast Training Center entered Arkansas, Missouri, Illinois, and Indiana, and the Gulf Coast Training Center moved into Kansas. The West Coast Training Center, most sorely pressed of all for good sites, had to build stations in western Texas and Colorado, where water and utilities were hard to obtain, elevations too high for efficient flying training, and the weather far from ideal.[125]

By May 1942 all forty-five of the new airfields added to meet the boosted requirements of the 50,000- and 70,000-pilot programs were ready for operation, and most of them had been utilized much ear-

lier.* These new stations with their tar-paper buildings were far from beautiful. Nor were they comfortable, for the men living in them were plagued with dust or mud, heat or cold, according to the location of the field. All had been put into operation before they were completed. At Marana, Arizona, for example, flying began on a level spot in the desert before landing strips were ready, and a detail of men had to fill rat holes in the earth each morning before the planes could take off.[126] The capacity of the training centers to meet their objectives depended also upon the expansion of facilities at older fields and the adaptation of some combat bases to training. During December 1941 the West Coast Training Center had taken over Kirtland Field at Albuquerque, New Mexico, to receive the bombardier school from Barksdale, which was transferred to the Third Air Force. The air base at Jackson, Mississippi, subsequently was taken over by the Southeast Training Center for the instruction of Netherlands East Indies cadets. Three of the 84-combat-group-program stations—Lockbourne, Smyrna, and Fort Worth—in 1942 became Flying Training Command four-engine pilot transition schools.[127] Auxiliary fields were obtained for each main training field, roughly on the basis of one field for each 100 cadets in training at the parent station. Subbases at Apalachicola and Naples in Florida added to the capacity of the gunnery schools at Tyndall and Buckingham Fields. At many stations facilities were stretched by reducing the allowance of barracks space to forty square feet per man, and by the use of tents, field kitchens, pit latrines, and other such temporary facilities.[128]

* The 50,000-pilot program airfields were:

Southeast Training Center—Ft. Myers, Fla.; Bainbridge, Ga.; Walnut Ridge, Ark.; Marianna, Fla.; Blytheville, Ark.; George Field, Lawrenceville, Ill.; and Monroe, La.

Gulf Coast Training Center—San Angelo, Tex.; Big Spring, Tex.; Eagle Pass, Tex.; South Plains Field, Lubbock, Tex.; Hondo, Tex.; Majors Field, Greenville, Tex.; Blackland Field, Waco, Tex.; and Coffeyville, Kan.

West Coast Training Center—Marana, Ariz.; Hobbs, N.M.; Pecos, Tex.; Deming, N.M.; and Carlsbad, N.M.

Aviation cadet classification centers were built for the Southeast Training Center at Nashville, Tenn.; for the Gulf Coast Training Center at San Antonio, Tex.; and for the West Coast Training Center at Santa Ana, Calif.

The 70,000-pilot program airfields were:

Southeast Training Center—Newport, Ark.; Stuttgart, Ark.; Greenwood, Miss.; Courtland, Ala.; Malden, Mo.; and Freeman Field, Seymour, Ind.

Gulf Coast Training Center—San Marcos, Tex.; Garden City, Kan.; Independence, Kan.; Strother Field, Winfield, Kan.; Aloe Field, Victoria, Tex.; Altus, Okla.; Frederick, Okla.; Pampa, Tex.; Laughlin Field, Del Rio, Tex.; Dodge City, Kan.; Childress, Tex.; Liberal, Kan.; and Bryan, Tex.

West Coast Training Center—Douglas, Ariz.; Kingman, Ariz.; Yuma, Ariz.; Marfa, Tex.; La Junta, Colo.; and Ft. Sumner, N.M.

At the time of Pearl Harbor the AAF Technical Training Command had an objective of 100,000 graduates per year. This goal was promptly raised to 300,000, and ultimately the load imposed reached a rate as high as 600,000. All planning, including that for facilities, was made the more difficult because student flow followed no fixed schedules during 1942 and 1943—indeed, it often fluctuated from week to week. Early in 1942 General Arnold directed the command to push its program of construction and to lease civilian facilities for more immediate needs.[129]

By March 1943 eight new technical training stations had been rushed into operation.* Since the construction of these stations was relatively simple, requiring only theater-of-operations buildings and limited airfield development, the time interval between the initiation of work and the actual use of the stations was fairly short. Construction costs, however, soared under the expedited procedures. By September 1945 the eight stations, with a combined housing capacity of 130,924, had cost over $120,000,000.[130] The roughly constructed facilities also caused hardships to the personnel so housed; respiratory diseases at Kearns, Truax, and Sioux Falls were an almost constant problem during the winter months, and inclement weather turned the partly completed camps into muddy bogs.[131] At the older stations an expansion of existing facilities, the reduction of the living space allotted per man, and the use of tent camps helped to accommodate the accelerating flow of students. One huge tent city at Jefferson Barracks housed approximately 12,000 men before deteriorating canvas and insufficient messing facilities caused its abandonment in June 1942. Overcrowding was common at most of the stations. Scott Field in March 1942 housed 12,505 enlisted men in barracks designed for 11,340. Sheppard Field barracks were so fully utilized that there was little more than sleeping room.[132]

Even so, the command got by only by the mass leasing of civilian facilities. Maj. Gen. Walter R. Weaver, taking over the Technical Training Command on 18 February 1942, seems to have decided fairly early that he could use the hotels of the nation, particularly those in resort areas, to house a part of his schools. To many military men this seemed a dubious experiment, and the policy also met with

* These new stations were a basic training center at Kearns, Utah; a basic training center at Seymour-Johnson Field, Goldsboro, N.C.; radio schools at Truax Field, Madison, Wis., and Sioux Falls, S.D.; and mechanics schools at Lincoln, Neb., Amarillo, Tex., Greensboro, N.C., and Gulfport, Miss.

criticism from civilian sources. General Weaver, however, maintained that "the best hotel room is none too good for the American soldier."[133] He moved his headquarters to the small resort community of Pinehurst-Southern Pines, North Carolina, and by the end of 1942 the Corps of Engineers, acting on his request, had leased hotels, apartment houses, and other miscellaneous buildings in Miami Beach, St. Petersburg, and Clearwater, Florida, and Atlantic City, New Jersey. Largest of these establishments was that at Miami Beach, where, at the peak, the Army housed approximately 82,000 men in some 326 hotels and apartments.[134] In the fall of 1942, when the quota of radio operators was suddenly increased from 48,000 to 101,000 in an augmentation to be accomplished before the end of the year, General Weaver secured condemnation proceedings enabling the government to take over three hotels in downtown Chicago. Other hotels were leased at Grand Rapids, Michigan, to serve a specialized weather school, and the AAF radar school was moved into a leased club at Boca Raton, Florida.[135] Other facilities leased for the command included the county fairgrounds at Fresno, California, the Federal Indian School at Tomah, Wisconsin, a preparatory school for boys at Pawling, New York, and some buildings at Yale University. Still other students were farmed out to civilian institutions for training and housing. In May 1943, shortly before such detached training was curtailed, the command had trainees in thirty-five contract technical schools, in thirteen civil mechanics schools, in eleven factory training schools, and in five machinists schools. Meteorology training was being given in five colleges and universities, and eleven similar institutions were giving clerical training.[136]

The use of leased facilities for the technical schools was undoubtedly less satisfactory than Army cantonments would have been, but it resulted in savings in labor and critical materials at a time when the nation's resources were hard pressed. The Senate war investigating committee later concluded that facilities obtained at Miami for an annual rental of $20,000,000 would have cost $100,000,000 and have taken six months to construct. It is also significant that the Corps of Engineers, in its much-criticized purchase of the Stevens Hotel in Chicago complete with furnishings for $6,000,000, later realized $441,000 from the sale of surplus furnishings and sold the hotel after it had been occupied for more than a year for $5,000,000.

Equally unusual in any history of war financing was the finding of the Senate committee that the facilities in Miami had been leased too cheaply for the good of their owners.[137]

Among the continental air forces, the First and Fourth Air Forces were so largely committed to defense assignments that their training activity required no new facilities aside from some additional housing. But the responsibility for unit training fell so heavily upon the Second and Third Air Forces as to require a major increase in their facilities.

The Second Air Force, upon being relieved from the defense of the upper Pacific coast in January 1942, was assigned the task of heavy bombardment unit training. For this mission it at first had only installations at Pendleton, Gowen, Geiger, and Salt Lake City, but in January it added Davis-Monthan Field at Tucson, Arizona, and in March the field at Wendover, Utah, was raised to air base level. By April all of these bases were being exploited to the utmost. At the request of Maj. Gen. Frederick L. Martin, commanding the Second Air Force, the Directorate of Base Services began action for the construction of new bases at Pocatello, Idaho; Great Falls, Montana; Salina, Kansas; and Casper, Wyoming.[138] Maj. Gen. Robert Olds, replacing Martin in May 1942, promptly submitted a plan for accomplishing all heavy bombardment training in the Second Air Force. He had decided to abandon the practice of giving full operational training at single stations in favor of a three-phase plan of training, each phase to last thirty days and to be given at separate airfields. Third-phase training required that each new group would divide and operate from squadron-sized airfields under simulated operational conditions. He proposed to locate new sites in Kansas, Nebraska, South Dakota, and Montana, to build up the fields at the Alamogordo, New Mexico, and Ephrata, Washington, bombing ranges to base level, and to use the airfield at Salt Lake City as an air force replacement processing station. The AAF approved the program early in June, and by July it had allotted the Second Air Force three new bases with oversized landing fields suitable for blind landings, three dispersed and eighteen other normal squadron-strength stations, and a new air base at Pyote, Texas.[139]

By August 1942 General Olds had located the blind landing fields at Clovis, New Mexico; Salina, Kansas; and a second site near Ephrata, Washington (Moses Lake Army Airfield). In December

he located a fourth oversized landing field at Mountain Home, Idaho. The location and construction of the squadron-strength airfields met continuing difficulties. In selecting sites in Kansas and Nebraska the Second Air Force ran into competition from the Navy and after a great deal of bickering succeeded in getting only one site out of the five desired. General Olds also thought that building was too slow. On 9 September, protesting the amount of time consumed in the preliminaries to construction, he warned that he would need all of the squadron fields by February 1943. In rebuttal, the Corps of Engineers disclaimed any responsibility for delay and showed that work had actually been begun within an average time of less than thirteen days after the issuance of construction directives.[140]

Completion of this tortuously developed expansion represented the peak of the construction of new installations for the Second Air Force. In connection with the 273-group objective, General Olds asked only for increased housing at five of the southernmost bases to enable them to take units displaced by winter weather in the north. In January 1943 he asked that nine of the squadron airfields he built up to group-strength stations so that they could be used for staging. Both projects were quickly approved by AAF Headquarters.[141] All of the new stations which the Second Air Force had requested built were in use by the spring of 1943;* thereafter, no new bases were built for this air force, and such additional facilities as it used were transferred from other AAF activities. Because of the southeastward shift in the air force's area of responsibility, it moved its headquarters to Colorado Springs in May 1943.[142] Construction of Second's sprawling complex of facilities had been speedily accomplished, but the very demand for speed caused four of the worst failures of the entire AAF base-development program. Work on runways at the Great Falls, Montana, base, and at its three subbases at Glasgow, Cut Bank, and Lewistown, had been continued through

* By May 1943 the Second Air Force was using newly built main bases at Wendover, Utah; Alamogordo, N.M.; Ephrata, Wash.; Mountain Home, Idaho; Great Falls, Mont.; Pocatello, Idaho; Casper, Wyo.; Pyote, Tex.; Dalhart, Tex.; Clovis, N.M.; Moses Lake, Wash.; and Walker, Pratt, and Great Bend, Kan. Its new subbases were at Watertown, S.D.; Mitchell, S.D.; Scribner, Neb.; Scottsbluff, Neb.; Cut Bank, Mont.; Glasgow, Mont.; Lewistown, Mont.; Redmond, Ore.; Madras, Ore.; Pierre, S.D.; and Ainsworth, Neb. The airfields at Salina, Kan.; Topeka, Kan.; Kearney, Neb.; Fairmont, Neb.; Grand Island, Neb.; Bruning, Neb.; Harvard, Neb.; Herington, Kan.; and McCook, Neb. were being used for concentration. It had obtained airfields at Blythe, Calif.; Gulfport, Miss.; Alexandria, La.; Galveston, Tex.; and Dyersburg, Tenn. through transfers from other AAF activities.

a very cold winter. Frozen aggregates had been graded into embankment fills, and with the spring thaws of 1943 the runways began to settle and break. Since the estimated cost of repairs to the four fields was regarded as excessive, the Second Air Force abandoned heavy bombardment training at the three subbases after only five months' use and gave up the main base in October 1943. The base at Great Falls continued in use by the Air Service Command, but the subbases soon passed to a stand-by status.[143]

The Third Air Force, though ultimately charged with all operational and replacement training for medium, light, and dive bombardment aviation and for a large part of the fighter-pilot replacement training program, was more fortunate than the Second. In January 1942 the Third had nineteen stations assigned to it which were suitable for its mission, and it also had access to a great number of CAA-improved civil airfields which could be made suitable for its use with the addition of housing and a few other improvements. It inherited, moreover, most of the air support fields which had been built adjacent to each Army combat troop post. By May 1943 it was using eleven main bases, twenty-three subbases, and sixteen auxiliary fields for operational and replacement training.[144] All but two of the main bases—those at Columbia, South Carolina, and Sarasota, Florida, both municipal fields which had been improved by the Army—were pre-Pearl Harbor stations. Practically all of the subbases and auxiliary fields were civil airfields which had been improved by the CAA.* Only in Florida, an area of heavy Army and Navy air activity, had the Third Air Force encountered any special competition for desirable sites, and incipient friction in that state had been virtually ended by the so-called Stratemeyer-Towers line drawn down the center of the state on 19 September 1942. By this demarca-

* In May 1943 the Third Air Force was using the following fields for operational and replacement training: Dale Mabry with subbases at Thomasville and Harris Neck Field, Ga., and Perry, Fla., and an auxiliary field at Carrabelle, Fla.; Drew with a subbase at Waycross, Ga.; MacDill with subbases at Lakeland and Jacksonville, Fla.; Sarasota with subbases at Bartow, St. Petersburg, Ft. Myers, and Tampa, Fla., and auxiliary fields at Immokalee, Lake Wales, Punta Gorda, and Winter Haven, Fla.; Hunter with a subbase at Chatham Field, Savannah, Ga.; Selfridge with a subbase at Oscoda, Mich.; Key with subbases at Ozark, Ala., Hattiesburg and Laurel, Miss., and an auxiliary field at Demopolis, Ala.; Will Rogers with subbases at Woodward, Ardmore, and Muskogee, Okla., and Marshall Field, Kan., and auxiliary fields at Gage, Hobart, Perry, and Tulsa, Okla.; Greenville with subbases at Greenwood and Florence, S.C., and auxiliary fields at Anderson and Spartanburg, S.C.; Columbia with subbases at Congaree and Walterboro, S.C., and auxiliary fields at Barnwell, Johns Island, North, S.C., and Dublin, Ga.; and De Ridder, La.

HEADQUARTERS, CHICAGO SCHOOLS, AAFTTC, UNIT NO. 1
(STEVENS HOTEL)

HOTEL LOBBY

TYPICAL HOTEL ROOM AFTER CONVERSION

GRAND BALLROOM AS MESS HALL

CLASSROOM BUILDING (THE COLISEUM)

tion the Navy took over rights in the entire east coast of Florida with the exception of small areas around Miami, Palm Beach, Boca Raton, and Jacksonville; the Army took over most of central Florida and the west coast from Key West to Pensacola.[145] This agreement was faithfully kept until December 1943, when both parties permitted local commanders to arrange variations from the general dividing line. In January 1943 the Third Air Force had stated that it needed only some additional housing to permit it to fulfill its obligations under the 273-group objective.[146]

The smallest of the AAF organizations conducting operational and replacement training was the I Troop Carrier Command, established on 30 April 1942 to train troop carrier wings and groups for airborne operations. The work of selecting the stations which the command would use had been undertaken by the Air Force Combat Command as a part of the air support base-development program. In June 1942 command headquarters were located in a cantonment adjacent to Stout Field, the municipal airport at Indianapolis, Indiana. In addition to Stout Field, the I Troop Carrier Command sponsored the building of eight new airfields, two of which it gave up without having occupied them, and the improvement of three pre-Pearl Harbor bases.* Its small program seems to have given little trouble, and by February 1943 it could report that it required no other facilities to complete its mission under the 273-group program.[147]

The short-lived I Concentration Command, established in June 1942 to expedite the movement of combat groups overseas but disbanded five months later, during the course of its short and troubled existence built or improved eight airfields which were later used by other AAF agencies. In July it assumed control of Selfridge, Baer, Syracuse, Kellogg, and Lockbourne Fields, each of which was improved to prepare it for staging. It also secured a leasehold on Lunken Airport, Cincinnati, Ohio, to serve as its headquarters. During the summer it took over the responsibility for completing the airfield at Dyersburg, Tennessee, which the Southeast Training Center had given up because of excessive grading costs, and began construction

* The I Troop Carrier Command transferred the fields at Blythe, Calif., and Ardmore, Okla., to the Second and Third Air Forces without occupying them. It gave the field at Florence, S.C., to the Third Air Force in March 1943. The three old fields regularly used by the command were Bowman, Lawson, and Pope. New fields were constructed at Austin, Tex. (Bergstrom Field); Laurinburg-Maxton, N.C.; Alliance, Neb.; Sedalia, Mo.; and Grenada, Miss.

to suit it for staging two heavy bombardment groups. It sponsored runway extensions and housing for a heavy bombardment group at the airfield adjacent to the aircraft assembly plant at Willow Run near Ypsilanti, Michigan. Selfridge and Kellogg were later transferred to the Third Air Force, Baer to the I Troop Carrier Command for staging, Lockbourne to the Southeast Training Center for use as a four-engine pilot school, Lunken to the Air Transport Command, and Syracuse to the Air Service Command. Dyersburg was transferred to the Second Air Force, which regarded it as an acquisition of dubious value, and a part of the housing at Willow Run was used by a Technical Training Command detachment.[148]

Having been made responsible for reorganizing the observation squadrons of the Army in the fall of 1941, the Air Support Section of the Air Force Combat Command and its successor, the AAF Directorate of Ground-Air Support, projected a system of airfields designed to serve air units training with the ground forces. It was originally assumed that extensive base development would be needed near the four army headquarters at New York City, Memphis, San Antonio, and San Francisco, and near the command post of the Armored Force at Fort Knox, Kentucky. Each corps headquarters post was also to have an adjacent air base, and each division post was to have a smaller base, built to accommodate one observation squadron for each division at the post. Additional bases were set up for the Desert Training Center maneuver area around Indio, California, and for troop carrier training stations.[149]

Actually, this plan was based upon an unrealistic assumption as to the development of air support in World War II. The large air support bases scheduled for construction near each army headquarters were never built, but at Memphis and San Antonio smaller bases were provided on leased airdromes. Only a part of the bases designed to occupy positions proximate to corps headquarters seem to have been constructed, and most of them were quickly diverted to other uses. The remainder of the project, however, was accomplished much as had been planned, and by June 1943 small fields had been developed near each Army Ground Forces divisional post. Most of these fields were CAA-improved municipal airports, and housing facilities varied considerably. Esler Field, Camp Beauregard, Louisiana, for example, could accommodate 200 officers and 2,200 enlisted men in July 1944, while the airfield at Rice, California, could

shelter only 20 officers and 100 enlisted men. The fields were usually organized as subbases of larger AAF installations in their vicinity, and most of them passed to the control of the Third Air Force during 1943.[150] The older air support bases were also improved, an activity which inevitably led to conflicts with local post commanders. At Gray Field, Fort Lewis, Washington, plans for the expansion of the airfield conflicted with others for the expansion of the post, and only after much friction and recrimination was an adjustment worked out. To relieve such situations, the AAF sought to secure complete autonomy for its airfields on Army posts and later to fix definite boundaries at each of its fields located on such posts, but both efforts were unsuccessful.[151]

The impact of World War II upon the AAF's supply, maintenance, and air transport functions produced three new commands—Air Service, Materiel, and Air Transport—each with its own special requirements for facilities. Of these, the Materiel Command, largely a testing and procurement authority established in March 1942 as successor to the Materiel Division,* needed fewer field installations than did the other two. Its headquarters and testing establishment at Wright Field, however, was tremendously expanded; between June 1940 and September 1945 construction and additional land purchased there cost $48,817,078, the largest amount expended at a single AAF base during World War II. During 1942, also, the command leased and improved the Clinton County Airport, Wilmington, Ohio, for use in testing gliders.[152]

The Air Service Command, responsible from late in 1941 for storage and maintenance of all AAF aircraft and technical equipment, required a much larger network of facilities. Each of the eleven air depots in operation or under construction in December 1941 was later expanded by ASC.† To meet a local maintenance need, the AAF permitted the command to locate an additional air depot at the 36th Street Airport, Miami, Florida. Fifteen months after work had begun there in February 1943, the new depot was in full operation. Between January 1942 and August 1944 new depot supply warehouses increased the available storage space from approximately 4,000,000 to approximately 24,000,000 square feet, but the mounting stocks of aircraft and materiel quickly overflowed

* See below, p. 294.

† For these depots, see below, p. 367.

these warehouses. Accordingly, the command leased as much commercial storage space as could be secured and sponsored the construction of other intransit and specialized depots. By August 1944 it held a total warehousing space of approximately 62,000,000 square feet, of which slightly more than two-thirds was government owned. Leased storage at that time included over 400 separate properties, rented for an estimated $4,000,000 a year. The command also utilized a varying number of air bases for training the service personnel, for storage, and to meet maintenance requirements in areas lacking adequate depot facilities. These airfields, developed by other AAF agencies, were inherited by the command as they became excess to other requirements.[153]

The Air Transport Command, shortly after its redesignation on 20 June 1942,* moved its headquarters to Gravelly Point, Virginia, adjacent to the National Airport. Besides acquiring Lunken Airport at Cincinnati, expanding responsibilities led to ATC's securing of such bases as Morrison Field, West Palm Beach, Florida, and Gore Field, Great Falls, Montana, both taken over in June. Two air support bases at Wilmington, Delaware, and Memphis, Tennessee, were occupied in May and November 1942. Two flying training units were established at Rosecrans Field, Saint Joseph, Missouri, and at Homestead, Florida. The former summer encampment area of the New Mexico National Guard at Camp Luna, Las Vegas, was developed for a technical training school, and an arctic training school opened at Camp Williams Field, Wisconsin. By February 1943 the ATC could state that, given no additional missions, it would not require additional building effort. In addition to the bases which it held in its own right, the ATC secured operating privileges at numerous bases along its ferrying and transport routes. Although it initially had trouble in maintaining these rights, the problem lessened when the rush of AAF operations in the continental United States began to taper off in the spring of 1943.[154]

In Florida the requirements of two special commands added to the difficulties experienced by the AAF in that area. The Air Corps Proving Ground, set up at Eglin Field in May 1941 for the testing of equipment under tactical conditions and given command status in April 1942, had developed by 1945 ten auxiliary airfields in the Choctawhatchee reservation, each devoted to a particular phase of

* See above, pp. 66-67.

testing operations. The reservation had been increased in size to 429,758 acres of land, most of which were owned by the government. Like the Third Air Force, the Proving Ground engaged in repeated controversies with the naval air station at Pensacola in regard to flying in the westernmost part of its reservation.[155] In central Florida the Fighter Command School and its successor, the AAF School of Applied Tactics, built up a still more ambitious testing and training establishment. The first school had been located at Orlando, Florida, in March 1942 for experimentation and training in the latest tactics of controlled interception.* Its subbases were nearing completion in November 1942 when the AAF activated the School of Applied Tactics at Orlando with a greatly expanded program of training in air defense, bombardment, air support, and air service.† The school ultimately constructed twelve airfields and used a number of other field installations to simulate a theater of operations in central Florida.[156]

During 1942 and 1943 the AAF continued to meet the same difficulties in locating bombing and gunnery ranges which it had encountered before Pearl Harbor. In the eastern United States high land prices made large reservations virtually impossible to obtain, and in the western states, where large tracts of public domain did exist, there were few areas, no matter how barren, in which someone had not acquired a vested interest. In locating its ranges the AAF made a determined effort to use only the least productive land available. Despite its difficulties, approximately 12,500,000 acres of land, an area larger than New Hampshire and Vermont combined, had been obtained for the AAF by June 1943, largely for use as ranges.[157]

The range needs of the First and Fourth Air Forces, concerned as they were with fighter training, were fairly easily supplied. The former developed a 14,677-acre reservation near Millville, New Jersey, as a gunnery range; the latter, controlling a part of the Tonopah range and the reservation at Muroc Lake, seemingly had ample facilities for its mission. The Second Air Force, however, met a number of difficulties. Despite strong opposition from cattlemen in Oregon and Idaho, the air force eventually secured two ranges in each state which were alternately used for bombing and for grazing. At Albuquerque it met delay in securing permission to bomb state-

* See above, p. 68.

† See below, pp. 684–93.

owned lands scattered throughout the public domain. At Blythe, California, the ubiquitous activities of the Desert Training Center held up bombing until December 1943, when a delimitation of activities permitted the use of four desert areas as part-time ranges. As late as September 1943 one Second Air Force wing commander stated flatly that the lack of ranges had made the air force's gunnery training program "merely eyewash."[158] The Third Air Force expanded its ranges without so much difficulty. By November 1943 it had a 218,908-acre range at Avon Park, Florida, and a combination of land and water ranges covering 223,147 acres at Myrtle Beach, South Carolina. Other large ranges were maintained in Hancock County, Mississippi, with 30,622 acres, and at Cherokee, Oklahoma, with 31,177 acres. Many of the Third Air Force stations used ranges over the Gulf of Mexico.[159]

There were additional demands for range facilities by the training air forces. To illustrate the needs of a bombardier school, it may be noted that Kirtland Field had twenty-nine bombing ranges assigned to it by October 1945. As for the gunnery schools, Las Vegas, Laredo and Kingman ended the war with 2,305,280-, 628,298-, and 161,997-acre ranges. Tyndall and Harlingen had combination land and water ranges, while Buckingham used a 960,000-acre range in the Gulf of Mexico. The Ajo–Gila Bend ranges, used by Luke and Williams Fields, occupied 1,123,135 acres. Radar bombing activities at Boca Raton used island targets in the Bahamas.[160] By June 1943 the AAF concluded, after a study, that only the Second Air Force still required any appreciable extension of its range facilities. And that need was considered met by the following October.[161]

Consolidation and Disposition of Facilities, 1943–45

During the latter half of 1943 the AAF reached the peak of its activity within the continental limits of the United States, and at the end of the year the number of its separate installations stood at the highest figure during the war: 345 main bases, 116 subbases, and 322 auxiliary fields.[162] The main task of the AAF had been to train and equip the air forces which now were deployed in increasing strength around the world. Not only had the back of that job been broken but subsidiary responsibilities—notably that of continental air defense—also had been greatly reduced by the close of 1943. Except for such operations as were required to maintain and augment the

great strength now deployed overseas, the time had come for a drastic cutback of AAF activity within the Zone of Interior.

With the bulk of base construction scheduled for completion by the spring of 1943, Arnold had warned his staff in January of that year that new projects must be curtailed. Every effort would have to be made to adapt existing facilities to new needs. The War Department in April 1943 specified the continuing flow of requests for small construction jobs as the nub of the problem henceforth. To the War Department's admonition as to the necessity for a cutback, the AAF added for its own people the precept that new facilities must be "essential" and not just "desirable." In August the War Department announced a general policy that no more land could be purchased unless failure to acquire it would seriously vitiate the use of land already owned. The blanket authority of division engineers to approve new construction projects costing less than $40,000 was revoked as of 31 December 1943. The volume of Army and especially AAF construction nevertheless remained high. During 1943 the total expended for AAF facilities amounted to about $548,039,000, while that for the AGF and ASF together totaled only about $362,368,000. General Arnold, displeased with this disparity, ordered on 14 January 1944 that future AAF construction be limited to that required to meet "critical requirements developing from changing operational needs for which existing facilities . . . are completely inadequate." More stringent regulations were issued, culminating on 27 February with General Arnold's personal order that no more AAF construction within the continental limits of the United States be authorized without his own approval. Despite the great amount of detailed work which this policy imposed on AAF Headquarters, it was rigidly interpreted and executed.[163]

The volume of AAF construction requests was reduced by these restrictive policies, but the flow of new projects was by no means dammed. In fiscal year 1945, for example, AAF construction cost approximately $168,000,000. With the defense responsibilities of the First and Fourth Air Forces greatly reduced, both of these organizations gave increasing attention to training. In October 1943 the First Air Force was charged to operate four heavy bombardment replacement training groups. Initially, the air force, directed to use fields constructed for the deceased Antisubmarine Command, was forbidden to build any new facilities, but later it became necessary to

expand housing at two stations. As the Fourth Air Force took responsibility for six heavy bombardment replacement training units, it obtained three stations for the purpose from the Second Air Force. Although some additional housing was permitted at Fourth Air Force stations, General Arnold was by no means generous. During 1943 and 1944, as a part of an effort to give each air force a more balanced training load, the Second Air Force received a fighter training mission and the Third Air Force some responsibility for heavy bombardment training, but in neither case was there a compensating provision for expansion of facilities.[164]

Most of the new construction was closely connected with the needs of very heavy bombardment training. Although for limited training the B-29's could use 6,000-foot runways, for full training they needed 7,000 by 150-foot runways designed to support a 120,000-pound gross load. Housing and maintenance requirements for very heavy bombardment groups, largest of all AAF combat units, were in excess of the facilities provided at most bases. The Second Air Force carried the main responsibility, and by the end of 1943 was conducting B-29 training at Salina, Great Bend, Pratt, and Walker, Kansas, and at Clovis, New Mexico. Housing, in particular, was inadequate at first, but during 1944 facilities at these fields and at thirteen others were expanded to fit them for B-29 groups. There was much anxiety that the older runways would not hold up, but by the fall of 1944 experience had indicated that with a high degree of maintenance they could be expected to last until the summer of 1946.[165] At the end of 1944 it had been decided to bring other training organizations into the B-29 program. The Training Command, scheduled to give transition training to B-29 and B-32 pilots, received authority to prepare Maxwell, Lowry, Randolph, Roswell, and Fort Worth for that purpose. In December the Third Air Force was authorized to expand Barksdale, Gulfport, MacDill, and Chatham Fields for B-29 operational training. The Fourth Air Force, although it would have participated more heavily had the war continued, received improvements only for Muroc, where it began to train B-29 lead crews in May 1945.[166]

The beginning of the employment of very heavy bombardment planes from the Marianas, together with the impending redeployment of air units through the United States to the Pacific, demanded a general increase of logistic facilities on the Pacific coast. During

1944 the AAF secured the construction of a $10,000,000 intransit depot at Alameda, California. It took over Camp Kohler at Sacramento for use as an overseas replacement depot. Mills Field at San Francisco was improved in a joint Army–CAA effort designed to provide extra space for the redeployment of air units, and Mather, Fairfield-Suisun, and Hamilton Fields were improved to meet the growing needs of the Air Transport Command.[167]

Some additional construction was permitted at other continental bases. Storage facilities continued to increase until the end of the war, so that by August 1945 the AAF held a total gross storage area of 87,241,000 square feet, of which only 14,813,000 square feet were leased. At Camp Springs, Maryland, a project for developing Andrews Field, originally a First Air Force defense airfield, into the headquarters post of the new Continental Air Forces was projected in September 1944, and by April 1945 some $10,000,000 had been allocated for improvements there. The AAF also took over a number of excess ground forces posts in order to meet its specialized needs, but these stations required little additional building.[168]

At the same time that the War Department and the AAF were making efforts to curtail new construction, both were seeking to dispose of their excess facilities. In December 1943 the War Department, citing the fact that personnel shortages demanded the closing of all excess stations, established a procedure for disposition of such property.[169] The AAF, however, had already begun to give up its surplus leaseholds. During May and June 1943 most of the contracts with civilian technical schools were canceled, over protests from the Aeronautical Chamber of Commerce. Movement of Training Command activities out of the hotels of Miami, St. Petersburg, Chicago, Detroit, and Atlantic City was well under way by the end of the year, but the AAF Personnel Distribution Command continued to occupy some hotels in the three resort areas. By the end of December 1943 the AAF had reduced its hotel leases from 464 to 216, and by the end of 1944 it held only 75 hotels.[170] It had also begun to dispose of its surplus airfields and ranges. In October 1943 the Navy had asked for any excess fields located near enough to the coasts to be of use for carrier pilot training. All commands were polled as to fields which could be transferred to the Navy, and in March 1944 a list of 84 stations was tendered for transfer. In giving these stations to the Navy, the AAF succeeded in getting

a commitment established that both air services could use the other's fields in an emergency, an agreement that might better have been enunciated in December 1941. Counting both the fields taken over by the Navy and those turned over to the ASF for final disposition, the AAF had disposed of 79 air installations by 30 June 1945.[171]

Despite the obvious advantage of being rid of its excess holdings, the AAF had to be fairly slow in giving up its bases until the needs for redeployment could be ascertained, needs which were by no means clearly determined even as late as April 1945. In general, the AAF preferred to retain all airfields which had housing and third echelon maintenance equipment until some clear estimate of the number of fields which would be needed by redeployment was settled. Most of the excess fields were therefore placed on a stand-by status, and, after December 1943, they were assigned to the Air Service Command for caretaking. These stations were used for prisoner of war camps, for housing foreign laborers, for grazing leases, or utilized in any other way consistent with their preservation. The number of fields kept on stand-by status varied from month to month, but on 1 September 1945 some 78 of the 401 main and subbases still retained and 74 of the 269 auxiliary fields then held were being kept on an inactive basis.[172] After the capitulation of Japan, surplus facilities were speedily released. During December the last of the leased hotels were returned to their owners, and by the end of the month the AAF held only 429 base installations, including 273 main and subbases and 156 auxiliary fields.[173] It was well on the way toward demobilization.

Problems and Achievements

In summary it may be well to speculate upon the value received from the $3,152,025,000 spent on AAF facilities in the United States during the war. Although the AAF had no direct control over the letting of contracts for construction, which fell within the province of the Quartermaster Corps and later of the Corps of Engineers, it did determine the extent of its needs and controlled the selection of its sites. These, of course, were the essential powers, and their possession by the AAF presents the critical questions.

On the whole, it can be said that the job of site selection was well done. In view of the extraordinary pressures, including those of time, little complaint can be made of the earlier choices of AAF

site boards, whether weather, terrain, strategic necessity, or some other factor be the criterion for judgment. Because of an early saturation of the more desirable air space, the AAF eventually had to take over many marginal sites, but the best sites were selected first and were the most highly developed.

The record suggests, too, that the effect of political pressure on the choice of sites, an old source of trouble to the Air Corps, was reduced to a minimum. Each station history begins with an account of the desires of the local community to obtain an air base, and it usually continues with the narrative of appeals made to interested senators and congressmen, if not of frantic trips to Washington. But nearly every member of Congress seems to have presented the cause of his constituents to the AAF, and the pressure behind any particular claim tended to be canceled out by the multiplicity of other ones. These pressures tended also to be reduced by the very immensity of the AAF program and of other programs which offered multiplying opportunities for the satisfaction of local aspirations. It was possible, moreover, for responsible officers to take refuge behind the urgency of national needs; the combat stations for the 84-group program, for example, were not located until after the necessary funds had been appropriated, thus eliminating pressure in Congress for selection of a particular site. As this fact suggests, the circumstances of a national emergency usually permitted the AAF to resist any purely political pressure. There were instances in which it was deemed advisable to yield to the extent of investigating sites considered undesirable, and some delays undoubtedly resulted. But such delays were perhaps more than offset by the free information supplied by interested groups who at times guided a hard-pressed staff to favorably situated sites.

Competition with the Navy for desirable air station sites, however, was a real problem and one which got worse after Pearl Harbor. AAF and Navy commanders on the west coast found that both had planned to take over many of the same civilian airports to meet a war emergency. In Washington State a quick agreement was made on the sharing of naval air stations with the Fourth Air Force for single fighter squadrons, but at San Diego, California, no satisfactory agreement was ever reached, and the AAF never considered that the city was adequately protected.[174] There was trouble in Florida throughout the war. Not until September 1944 did the two services

work out an agreement which permitted the Army and the Navy to use each other's air facilities freely in the event of an emergency —a delay in coordination that could have hampered defensive efforts in the event of attack. Both the Army and Navy, moreover, built up their air facilities with little or no reference to each other, spending more money and effort than might have been needed for an integrated program. Arrangements for transferring excess AAF airfields to the Navy were slow in development; the request for transfer which came in October 1943 was not acted on until March 1944. While the Interdepartmental Air Traffic Control Board helped to coordinate the Army and Navy programs, it lacked sufficient power. It should be noted, however, that fuller provision for coordination might well have imposed serious administrative delays on an AAF program which met its time schedules in large part because of decentralized controls.

This decentralization of control, on the other hand, made the AAF liable to the fault of overbuilding. Despite directives insisting upon all possible economy, each agency, rather than be caught short at a critical moment, tended to interpret its needs in terms of anticipated peak loads. Even at the point of fullest utilization, in March 1943, the AAF occupied only 73.2 per cent of its existing housing capacity.[175] That this figure represents a good deal of overbuilding at some points is hardly to be debated, but it should be interpreted in the light of circumstances making some such surplus virtually unavoidable. Early plans for expansion of facilities had necessarily been drawn without full awareness of the effect hostilities would have on requirements. The emphasis within build-up programs shifted in accordance with changing conditions in a variety of overseas theaters. New demands on the home front might be taken care of through transfers of existing facilities, but base facilities could never be completely interchangeable. When B-29 training began, it was necessary to expand some stations while other bases stood virtually idle. Some bases having served their purpose, though for only a short time, could not readily be adapted to other uses and would become surplus. Thus, the troop carrier base at Grenada, Mississippi, was in active use for only ten months.[176]

One point in closing should be emphasized. The AAF met its strategic commitments without any serious delay that was attributable to a failure in the development of base facilities.

SECTION II

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EQUIPMENT AND SERVICES

CHAPTER 5

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THE DEFINITION OF POLICIES

DURING World War II the United States conceived, constructed, and employed with devastating success the largest and most powerful air force the world had yet known. In the fullest sense it was a triumph of the American people as a whole, for it was the product of a truly national effort, a remarkable collaboration among the scientific, industrial, and military components of American society. But considerations of space and balance make it possible here to attempt no more than an account of the AAF's part in the common effort to provide the weapons and the logistical support which underwrote the massive combat operations of the war.

The Air Corps in 1939

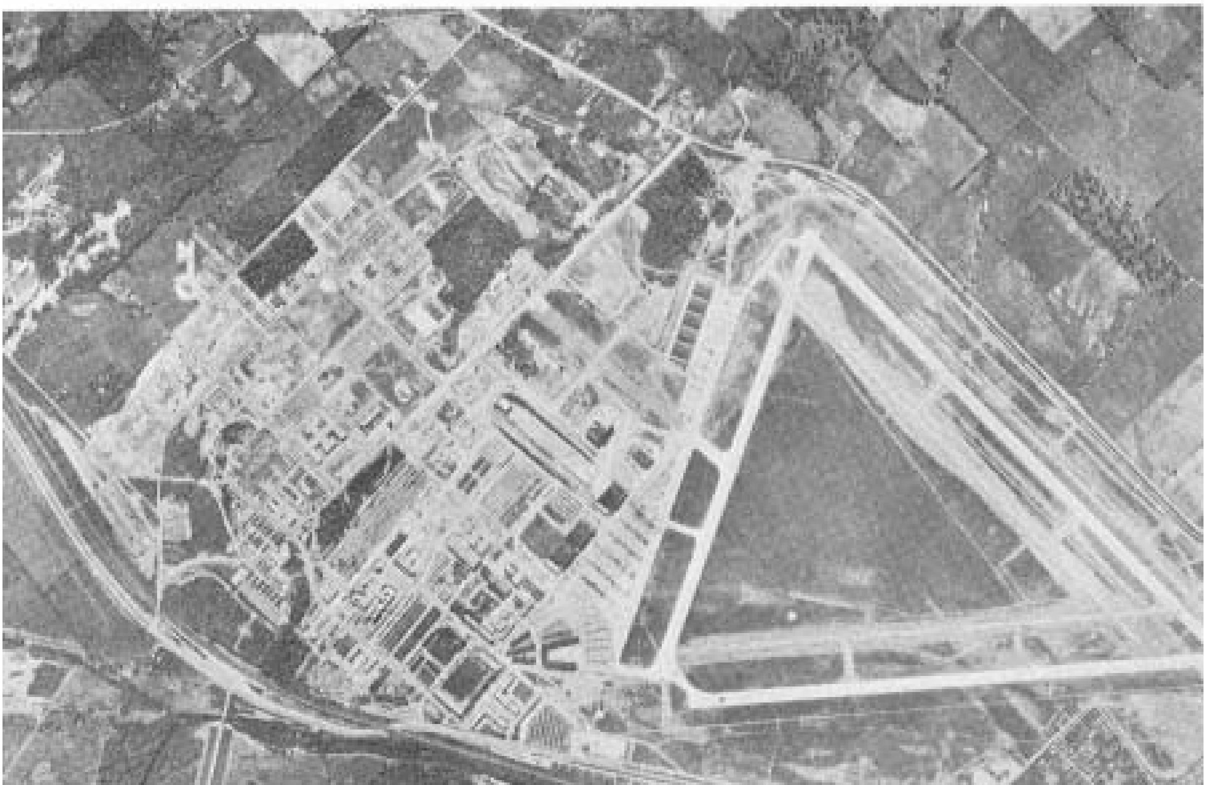
Prior to 1939 the Air Corps, like the rest of the U.S. Army, had suffered the neglect which was then the usual lot of our armed forces in peacetime. Although the Air Corps Act of 1926 had established a maximum strength of 1,800 serviceable planes for the Army, to be attained in 5 years, the number actually on hand 10 years later was only 946.[1] In June 1936, Congress accepted the recommendations of the latest of the many boards which periodically examined the mission and needs of the Air Corps and sanctioned a maximum Air Corps strength of 2,320 planes, which the Air Corps hoped to attain by 30 June 1940.[2] As a result of this legislation, congressional appropriations for the Air Corps during fiscal years 1937–39 were almost double those of the preceding three years, reaching over $70,000,000 in 1939, as compared with barely $30,000,000 in 1935.[3] But in the face of events in Europe and the Far East it became apparent to many people, and especially to President Roosevelt, that much more would be required. On 30 June 1938, the year in which

the President launched a new program of expansion, our total Army air strength was only 1,401 planes, of which fewer than 900 (and many of them obsolescent) could be classed as combat planes.[4] The existence of a comparable situation in the Navy had been noted in time to make a 3,000-plane program a significant feature of the Naval Expansion Act of May 1938.[5] By fall it had become apparent that the Air Corps too must be re-equipped and greatly expanded.

The Office, Chief of Air Corps and the War Department General Staff (WDGS), assured of a favorable reception by the White House, drafted suggestions for increases in the size of the Air Corps, ranging up to a total strength of 7,000 planes.[6] At a White House conference on 14 November the President raised the figure to 10,000 planes, suggesting an Air Corps equipped with 3,750 combat planes and 2,500 training planes, with 3,750 combat planes in reserve. His primary interest at this time seems to have been to build up the American aircraft industry to a point where it could provide France and England with the planes which would enable them to stand up to Germany,[7] but there can be no doubt that the Chief of the Air Corps and the WDGS conceived their responsibility to be the development of a balanced U.S. air force. To that end the Air Corps immediately directed its full if still limited resources.

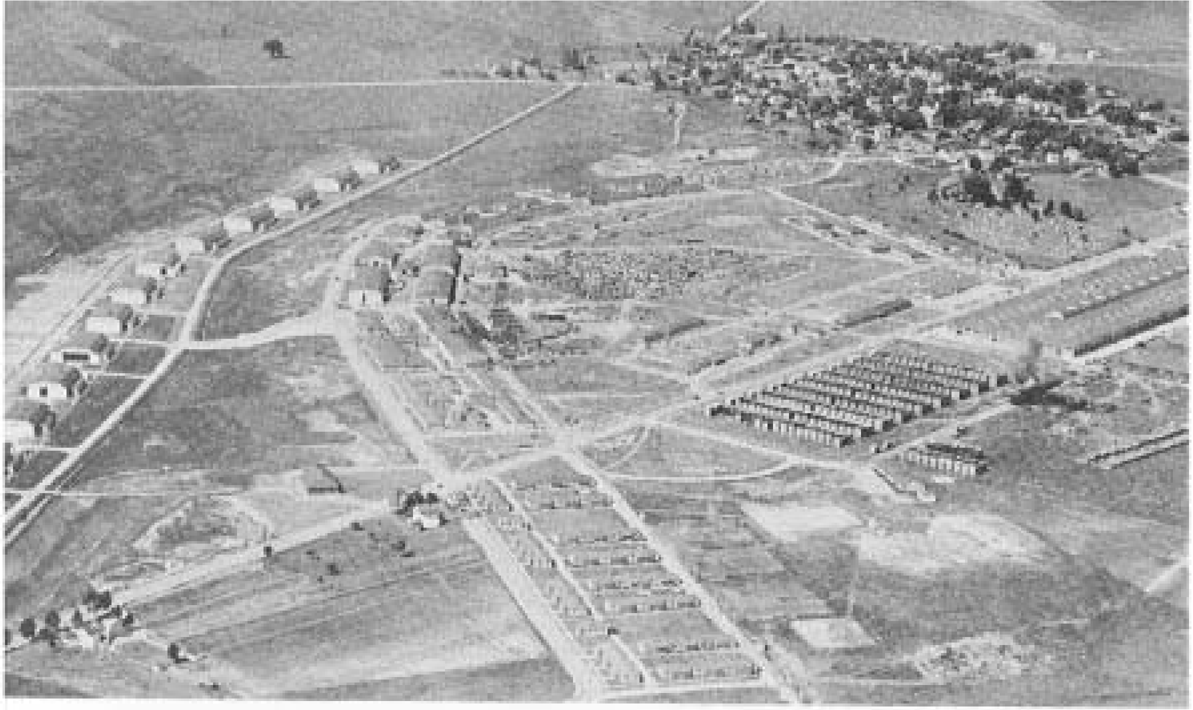
Air Corps plans drawn in December for the 10,000-plane air force provided for 5,620 combat planes (of which 2,915 would be in reserve), 3,750 training planes, and 630 miscellaneous planes. The War Department, however, seeing an opportunity for strengthening the Army's ground components, succeeded in convincing the President that only $300,000,000 of the $500,000,000 he intended to request from Congress should go to the Air Corps, and that only $180,000,000 of this sum should be used for combat planes. The practical outcome was to place a limit of 6,000 on the proposed aircraft strength.[8]

The President's message to Congress on 12 January 1939 asked that $300,000,000 be allotted for a "minimum increase of 3,000 planes," and expressed the hope that "orders placed on such a large scale" would "materially reduce the unit cost and actually provide many more planes." He suggested that $50,000,000 be appropriated immediately in order to permit acceleration of aircraft production.[9] By 3 April, Congress responded to the President's appeal for this "minimum program for the necessities of defense" by passing a bill which authorized the Secretary of War to "equip and maintain the



WRIGHT FIELD, OHIO

Above: JUNE 1934 *Below:* SEPTEMBER 1944



PATTERSON FIELD, OHIO

Above: January 1933 *Below:* September 1944

Air Corps with not to exceed *six thousand* serviceable airplanes . . . together with spare parts, equipment, supplies, hangars," and other such requisites. The act authorized appropriations up to $300,000,000, to which would be added the necessary sums for maintenance of an air force of that strength. The number of planes authorized included those necessary for the training and equipment of the National Guard and the Organized Reserve.[10] This authorization was followed by further legislation appropriating funds and providing contractual authority to bring the strength of the Air Corps up to 5,500 planes —the program finally decided on by the Air Corps and the WDGS as the most feasible of attainment within the $300,000,000 to be made available. The appropriations would make possible the procurement of 3,251 planes—double the number on hand in the Air Corps at the beginning of 1939. Air Corps leaders hoped to achieve by 30 June 1941 a balanced air force of 5,500 planes,* with a complement of 48,000 officers and enlisted men and the organization necessary to operate such a force.[11]

When Germany pounced on Poland in September 1939, the Army's air arm had barely embarked on its new program of expansion. At the close of 1938, the statistics showed a first-line combat aircraft strength of less than 500 planes† (not including observation planes) and a personnel of 2,337 officers, 29 warrant officers, and 19,301 enlisted men (including flying cadets). Not without reason did Maj. Gen. Frank M. Andrews, commanding the GHQ Air Force, describe the Air Corps in January 1939 as a "fifth rate air force."[12] At the end of August 1939, on the eve of war, the Air Corps had a strength of 2,720 officers, 27 warrant officers, and 23,779 enlisted men (including 860 flying cadets). Of the approximately 1,500 tactical aircraft,‡ only about 800 were classified as standard or first-line, and of the 59 "skeletonized" squadrons, 3 were balloon and 10 were observation squadrons. The 26,526 officers and men in the Air

* The Navy, which had to gear its expansion of aircraft strength to its carrier program, planned to attain its maximum strength of 3,000 planes in fiscal year 1944.

† A comparison with the U.S. Navy reveals that as of 30 June 1938 the Navy had more than 800 aircraft which were classed as first-line, and as of 30 June 1939, more than 900 first-line planes. Actually, many of these planes would have been classified as obsolescent had there been anything with which to replace them, for several hundred of them were old biplanes and far behind Air Corps planes in performance.

‡ Of the 1,500 total, more than 300 were observation planes used chiefly for artillery spotting, liaison, and observation within corps and division sectors.

Corps represented some 14 per cent of the total strength of the Army.[13] By contrast the German Air Force in September 1939 had a personnel strength of over 500,000 and a first-line aircraft complement of 3,750 planes, supported by a 10 to 25 per cent reserve of first-line planes. The Royal Air Force at the same time had over 100,000 officers and men and at least 1,750 first-line planes.[14]

The disparity between the Air Corps and these European air forces was even greater than statistics on the number of aircraft would indicate. Probably only in the quality of its officers and men could the Air Corps compare with the Luftwaffe and the Royal Air Force at that time. American pilots and mechanics were well trained and the greater number of Air Corps men were veterans of many years' service. But this hard core, invaluable as it was as a cadre for the new air force, could not be considered an air force in being. It would require several years of expansion and development before the United States could regard itself as a peer among the air powers of the world. Fortunately, time and geography were on our side.

A more detailed comparison of the Air Corps with the Luftwaffe as of September 1939 illustrates vividly the relative unpreparedness of the former. As against the total of 26,000 officers and enlisted men in the Air Corps, the German Air Force could show at least as many in its Air Ministry and headquarters staffs alone, 50,000 to 75,000 aircrewmen, some 75,000 men in airfield servicing units, 75,000 to 100,000 in signal units, between 50,000 and 75,000 in airfield construction work, 75,000 in maintenance and supply services, and 50,000 to 75,000 in training. The Luftwaffe, moreover, had the air bases and other installations needed to support a modern air force.[15] The number of first-rate military air bases in the United States could almost be counted on the fingers of both hands.* The Air Corps lacked not only bases but also the organization and equipment with which to build them. Fortunately, the construction industry in the United States could and eventually did meet the need. As for other deficiencies, the Air Corps had too few signal personnel, its maintenance and supply organization was inadequate, its headquarters staffs were all undermanned and overworked. Although it received substantial supply, maintenance, and technical support from the Army—particularly from the Corps of Engineers, the Ordnance Department, and the Quartermaster, Signal, and Medical Corps—the Air Corps lacked the capacity

* For a discussion of air base development, see above, Chap. 4.

to employ to maximum effect even the limited number of planes at its command. The supporting machinery had yet to be created, and the approximately 2,000 pilots and 2,600 aircraft mechanics were all too few.[16]

Even the planes with which the war was to be fought had yet, with few exceptions, to be developed. Of all the models of aircraft on hand in the Air Corps in September 1939, only one—the B-17—actually flew as a first-line plane during World War II. The roster of then current aircraft types is completely unfamiliar to Americans who well remember the Mustang (P-51), the Marauder (B-26), the Thunderbolt (P-47), or the Liberator (B-24). In 1939 the B-18 was the standard bombardment plane, the A-17 the standard attack plane, and the P-36 the standard fighter; almost 700 of the 800 first-line combat aircraft of the Air Corps consisted of these three models. By the time of America's entry into the war two years later, all of them would be obsolete.[17]

The Air Corps was well aware that its planes had been accurately described by President Roosevelt in January 1939 as "antiquated weapons."[18] The latest model of the P-36 had an operating speed of 270 miles per hour, a ceiling of 32,000 feet, and a maximum armament of three .30-caliber and one .50-caliber machine guns. The chief British fighters—the Spitfire and the Hurricane—were both far ahead of the P-36 in performance. The former—soon to be recognized as the best fighter in the world—had an operating speed of 312 miles per hour, a ceiling of 35,000 feet, and an armament of eight .303-caliber machine guns. The Me-109, best of the German planes and second only to the Spitfire among the fighters of the world, had an operating speed of 298 miles per hour, a service ceiling of 36,000 feet, and it carried two machine guns and two 20-mm. guns.[19] The contrast was all the more significant because the P-36 was at the height of its performance potential in 1939, while the German and British fighters were still capable of further developments and would show significant improvement in performance during the course of the war. In its attack bombers, the United States was even more outclassed. The German Heinkel 111, Dornier 17, Junkers 87, and especially the Junkers 88 (available only in small numbers in September 1939), were all superior to the American attack bombers. The highly overrated Ju-87, a single-engine monoplane which became famous as the dread *Stuka* dive bomber in 1940, had a maximum speed of 245 miles

per hour and a cruising speed just under 200 miles. The Ju-88 had a top speed of nearly 300 miles per hour and a cruising speed of 260. It could carry a bomb load of 2,200 pounds and was armed with three machine guns. The American A-17, by contrast, was a single-engine monoplane with a maximum speed of 220 miles per hour and a cruising speed of 170; it carried five .30-caliber machine guns and a normal bomb load of 654 pounds. It had a service ceiling of 19,400 feet.[20] The British had no outstanding plane in this category.

Only in the field of heavy bombers did the Air Corps hold first rank. The B-17 was superior to the Focke-Wulf of the Germans and the Manchester of the British, but in September 1939 the Air Corps had only twenty-three (including three experimental B-17A's) Flying Fortresses. American commercial transport planes could more than stand the test of foreign competition; they provided the promise of a superior military air transport service, but such a service did not exist in 1939.[21]

If the United States was not a "fifth rate" air power in 1939, it certainly ranked no better than third or fourth. Its inferiority was both quantitative and qualitative, and only the prospect that world events might permit the time necessary to overcome these disadvantages offered ground for hope that the Air Corps could be made ready for any emergency. Given time, the nation's potential resources for aircraft development and production might be effectively mobilized: it could be expected that a nation which prided itself on its productive genius would provide the means for overcoming the quantitative disadvantage, but this would count for little unless production in quantity measured up to qualitative standards set by the intense rivalry of actual warfare.

Resources for Research and Development

The emergence of the airplane as a major weapon had confronted military leaders with problems of technological development which became ever more pressing and critical. Even in peacetime, the rate of obsolescence in aviation equipment was so high as consistently to give the Air Corps first claim upon Army funds available for research and development. Profiting also by the intimate ties which bound together in a common adventure all leaders in the field of aviation, whether civil or military, the Air Corps had kept well abreast of world developments until the mid-1930's, when the unveiling of the

German Air Force inaugurated a period of intense competition. The difficulty after 1935 is suggested by comparative figures on the anticipated longevity of military planes as first-line equipment. As of 1 September 1934 the first-line longevity of Air Corps models was six years for pursuit, attack, and bomber aircraft; eight years for observation planes; and ten years for all others. By 1 September 1939 first-line longevity was estimated at four years for pursuit, five years for attack and medium bomber, six years for heavy bomber and observation, eight years for transport, and ten years for all other aircraft.[22] In 1934 and 1935 official War Department boards had stated confidently that Air Corps equipment was "equal or superior, with few exceptions, to that of any other nation."[23] By 1939 the Air Corps and such civilian leaders as Dr. Vannevar Bush were one in warning of the need to catch up with the progress of other countries.[24]

The situation in 1939, of course, reflected in part the inadequacies of earlier programs of research and development. Three considerations had been fundamental to the shaping of those programs: 1) a national policy resting upon the assumption that we would fight only a strictly defensive war, 2) an uncertain delineation of responsibilities between the two services for defense of the immediate approaches to the United States, and 3) the limited funds available. Air Corps expenditures for research and development during the 20 years since the close of World War I had ranged from a low of $2,184,000 in 1927 to a high of $5,966,851 in 1936. From 1933 onward the total had averaged over $4,000,000 per year until fiscal 1939, when it dropped to $3,574,209—a sum, incidentally, only half the amount spent that year for research by E. I. du Pont de Nemours and Company.[25] The high point of appropriations available for research and development had coincided with the clarification of the Air Corps' mission that opened the way for development of the long-range bomber, which in 1939 represented the chief, and a highly important, result of previous development programs. Everything considered, the Air Corps in maintaining first rank in this major category had done perhaps as well as could have been expected in the circumstances. Perhaps it could be argued that too much of its limited energies had been concentrated on the long-range bomber. But, in any case, the disturbing uncertainties which had characterized official policy as to the proper mission of the Air Corps since 1936* made clear an immediate need

* See above, Chap. 1.

for a well-defined and well-rounded program of development closely geared to the anticipated needs of national policy.

A special air board, appointed by the Chief of Staff in March 1939 to review the over-all problem, warned in its report in the following September that failure to "anticipate potential developments in such a rapidly progressing science as aeronautics inevitably will result in the supply of aircraft to the armed forces with characteristics that are ineffective against enemy weapons." The report emphasized the need for coordination of the basic and applied research activities of the country, advocated that the War Department adopt a policy of "long term, adequate and continuing research, experimentation and development of aviation based upon the 'pay as you go' principle," and recommended that the Chief of the Air Corps be directed to prepare for approval a five-year research and development program subject to annual revision.[26] Such a program had already been outlined by an Air Corps board appointed by Arnold in May 1939 and headed by Brig. Gen. Walter G. Kilner.* The report submitted by the Kilner Board on 28 June 1939 contained a comprehensive outline of proposed military characteristics for aircraft, weapons, and equipment that could be procured by 1944, and sketched an administrative plan for a major research and development program to be undertaken in the interval.[27]

Addressing itself to the basic problem of formulating desired military characteristics, the board realistically concluded that "efficient airplanes are a compromise between requirements for military use and technical features of design." Current procedures, it was found, restricted the technical staffs of the Air Corps and the aircraft manufacturers in "determining the best compromise of technical features that will result in the best airplane for military use." For the purpose of facilitating practical compromises between aircraft manufacturers and the Air Corps in the development of new equipment, it was proposed that desired military characteristics be stated in terms as general as was possible. The board gave first priority to the development of liquid-cooled engines of various types with a range in horsepower from 1,500 to 2,400—a program basic to the improved performance of all classifications of planes. It noted the need also for a 3,000-horsepower engine if a truly long-range bomber were to be developed.

* The other members of the board were Lt. Col. Carl Spaatz, Lt. Col. Earl L. Naiden, Maj. Alfred J. Lyon, and Charles A. Lindbergh.

Second priority went to fire-control apparatus, a major deficiency in current Air Corps equipment. In third priority came the development of superior fighter (pursuit) aircraft—a recommendation undoubtedly prompted by the Spitfire and Me-109. The chief pursuit types recommended were a single-engine interceptor of maximum obtainable speed with endurance of one hour at that speed, and a twin-engine fighter with a tactical radius of 300 miles and the maximum speed obtainable. Desired speeds ranged up to 500 miles per hour. The advanced bombardment types which should be developed by 1944 included a long-range bomber with a 3,000-mile tactical radius, a maximum speed of 400 miles per hour above 20,000 feet, and a bomb load of 4,000 pounds; a heavy bomber with a 2,000-mile radius, high speed of 375 miles per hour above 20,000 feet, and a bomb load of 2,000 pounds; a two-engine medium bomber with a 1,000-mile tactical radius, speed of 400 miles per hour, and a normal bomb load of 600 pounds; a two-engine light bomber with a 300-mile tactical radius, high speed of 400 miles per hour, and a bomb load of 1,200 pounds. Other priorities called for a special high-altitude photographic plane, for flight-test research, and for studies in the problems of mass production.

Concerned as it was with the immediate problems of shaping a practical program realistically based on current technological achievement, the Kilner Board omitted the mention of projects lying on the frontiers of scientific research—such as jet propulsion, guided missiles, and radio aids. The same concentration on objectives that seemed to be more immediately obtainable was reflected in the subsequent decision to drop the project for a bomber with a 3,000-mile radius from the budgetary estimates for the fiscal year 1941 in order to concentrate on the 2,000-mile-radius bomber. With this one exception, the report of the Kilner Board was accepted as the authoritative statement of the more immediate goals of the Air Corps.[28] Anticipated budgetary needs for the new research and development program were indicated by the board's recommendations for the expenditure of $21,813,000 in 1940, $23,421,235 in 1941, $21,213,325 in 1942, and $20,313,325 for each of the two remaining fiscal years. These sums would cover expenditures for experimental airplanes, special projects, engines and propellers, accessories and armament, plant maintenance and overhead, payrolls, and service-test equipment. The totals did not include funds to be expended by the technical services of the Army—

more especially, Signal, Ordnance, and Engineer—for research and development of direct benefit and importance to the Air Corps.*

As with all other phases of its operations, the Air Corps was subject to the higher authority of the War Department in the formulation and execution of its programs, and it could depend upon several of the Army's technical services for assistance in the development of materiel peculiar to air operations. Within the Air Corps, the Materiel Division, headed in September 1939 by Brig. Gen. George H. Brett, carried the primary responsibility; located at Wright Field in Dayton since its creation in 1926, it controlled directly the chief experimental installations belonging to the Air Corps—also located at Wright. The division's experimental engineering section supervised nine laboratory branches: aircraft, power-plant, propeller, armament, flight-test, photographic, equipment, materials, and engineering shops. An aircraft radio laboratory at Wright Field was under the control of the Signal Corps.[29]

In 1939, Wright Field was an impressive installation with special hangars and other experimental facilities in addition to its laboratories —the whole comprising a plant valued at $10,000,000—and for fiscal year 1940 the Air Corps planned to spend $6,481,000 for the construction of additional facilities. The majority of its staff of almost 2,000 (of whom approximately 90 per cent were civilians) was engaged in experimental and related activities, the rest for the most part in procurement. Although the Materiel Division also operated the Air Corps Engineering School at Wright Field, the number of engineering officers trained was small, the Air Corps depending heavily upon civilian engineers. The general shortage of officers in the Air Corps had resulted in priority being given to flying operations; only later would the Air Corps attempt to provide more fully for its engineering needs from within its own ranks.[30]

Outside of its own resources and those of the War Department, the Air Corps could draw upon the results of experimental work undertaken by the Navy's Bureau of Aeronautics[31] and the basic research undertaken in a variety of fields by the Bureau of Standards.[32] Of the greatest aid to the Air Corps (and to the Navy and the aircraft industry as well) was the work of the National Advisory Committee for

* The Kilner Board could the more easily omit from its report recommendations for development of radio aids because research in this field fell within the province of the Signal Corps.

Aeronautics, established in 1915 for "scientific research on the fundamental problems of flight."[33] Its main laboratory, located at Langley Field in Virginia, was well equipped and modestly but expertly staffed; its appropriation for 1939 exceeded $4,000,000, but much of this sum was for construction. By 1939 the work of NACA had come to be governed in large measure by the needs of the Air Corps and the Navy Bureau of Aeronautics, which claimed a constantly increasing share of its services; hence, in June of that year the President placed it under the supervision of a newly established Aeronautical Board, jointly representative of the Army and the Navy.[34]

The Air Corps had found little occasion as yet to draw directly upon the potentially great resources of the American universities. It had enjoyed the benefit of several projects in fundamental phases of the physical sciences sponsored by the NACA and the National Academy of Sciences, and the Materiel Division had made suggestions to universities with facilities for aeronautical research as to areas that might be usefully studied. But in 1939 one contract for $15,000 represented the Air Corps' only effort to employ academic facilities for its own purposes.[35] Its research program continued, however, to depend heavily upon the assistance of the aircraft industry.

The resources for scientific research maintained by American industrial corporations were to prove a major asset to the nation in its preparation for war. In 1938, 1,750 corporations maintained 2,237 research laboratories staffed by 44,292 persons and spent for research a total of approximately $100,000,000. This compared with approximately 435 laboratories and $10,000,000 in England. Within the aircraft and allied industries at least 34 and probably 45 or 50 of the 125 or more companies had substantial design departments and laboratories, and at least several maintained laboratories which made important contributions in pure research. In a comprehensive survey of the aircraft industry in 1939 the Aeronautical Chamber of Commerce of America reported that American aircraft manufacturers had spent $44,000,000 in research and development during the previous five years.[36]

In fields of research bearing directly on military needs, the work of the aircraft industry was largely, if indirectly, subsidized by the Air Corps and the Navy Bureau of Aeronautics. Although companies in allied industries of importance to the Air Corps—such as the Aluminum Company of America, General Electric, Eastman Kodak, Stand-

ard Oil—were strong enough to maintain large research organizations, most of the manufacturers in the aircraft industry were too small to provide for this need out of their own resources. Consequently, the Air Corps found it necessary to make available to them through experimental contracts the funds necessary for designing, building, and testing new aircraft, engines, and other equipment. Such contracts with the industry probably absorbed the greater part of the research and development funds available to the Air Corps. For fiscal year 1940, beginning 1 July 1939, the Air Corps used more than 60 per cent of its $10,000,000 research and development fund for payment on contracts for experimental or service-test airplanes, engines, propellers, and other equipment.[37]

These contracts were let on the basis of design competitions among several manufacturers, each company submitting a bid based on engineering data secured at its own expense. A contract was then awarded to the successful competitor for construction of experimental planes—usually three. If the experimental model met established tests, the manufacturer might be awarded a production contract. Since the cost of the experimental models usually exceeded the amount actually stipulated in the contract, the Air Corps permitted the manufacturer to include the unabsorbed portion of his developmental costs in the final contract. It was a system honored by long practice, but there were disadvantages for both parties to the contract. Unsuccessful competitors could not be reimbursed for their designs and, consequently, only the larger companies could afford to compete. By 1939 both the Air Corps and the manufacturers strongly favored a plan of negotiated experimental contracts with direct payment to the contractor for the work done, but such a policy did not come fully into effect until 1942.[38]

Resources for Production

If the quality of its aircraft was of major concern to the Air Corps in 1939, quantity of production was no less a pressing consideration. Indeed, from the very beginning of its unprecedented expansion the Air Corps found itself under the heaviest pressure to meet its quantitative goals even at the expense of qualitative standards. Fortunately, American scientific and industrial resources protected the Air Corps from a truly dangerous compromise, but the problems of production in 1939 were as immediate as were the problems of development.

Previously drawn plans for industrial mobilization proved to be of

little assistance. Since 1920 the Assistant Secretary of War had possessed statutory authority and responsibility in this area of planning. In addition to the War Department organization developed by the Assistant Secretary, there was also the Army-Navy Munitions Board, an effective instrument during the 1930's for coordinating the requirements of the two services.[39] Within the Air Corps, industrial planning was handled by the Industrial Planning Section of the Materiel Division at Wright Field, and by Air Corps officers on duty in the Office of the Assistant Secretary of War. But the funds made available had never been sufficient to permit the breadth and depth of study necessary to produce the kind of mobilization plan the Truman Committee found lacking in 1941.[40] Moreover, the planners not surprisingly had failed to envision the full scale either of the war that would be fought or of the part that would be played by the airplane. The projected maximum Army mobilization of 4,000,000 men included an Air Corps of only 200,000, with a complement of 12,000 aircraft, many of them observation planes. Air Corps procurement programs and plans for industrial expansion were accordingly modest in the extreme—and hence extremely unrealistic in terms of the demands of 1939–41, not to mention 1942–45. Procurement studies prepared in connection with a Protective Mobilization Plan of 1939 called for production of more than 24,000 tactical and training planes for the Air Corps during the first 12 months after M-day, with the industry attaining a production rate of 1,000 aircraft per month in the third month after M-day. These requirements, of course, were far beyond the existing capacity of the aircraft industry which in 1938 had produced a total of 3,623* planes, only half of them of military types.[41]

Existing mobilization plans were naïve in other respects also. The General Staff required that only planes which it had accepted as standard could find place in production plans. The result was that planes already obsolete or rapidly becoming so—the B-10, B-12, and P-26, for example—continued to hold prominent positions in procurement programs until 1939. Developmental models of the P-38 and P-39 could not be included, because they had not yet been accepted as standard. Probably the most unrealistic of assumptions was the one that aircraft designs could be frozen as of M-day and that industry could then proceed to produce standard types without change or interruption.[42]

* The figure does not include civil aircraft exported.

By August 1938 the Air Corps had sufficient "misgivings concerning the war productivity of American Industry in the matter of aeronautical products" to summon a conference of the aircraft industrialists, including representatives of airframe, engine, propeller, and instrument companies.[43] At the meeting on 6 September the participants explored the capabilities of the aircraft industry to meet emergency requirements and the problem of achieving mass production more quickly in wartime. After due consideration of the varied factors involved, the consensus was that the "only thing to do was throw away all the present war plans." The manufacturers could not supply the detailed information needed to enable the Air Corps to plan production to meet its stated requirements—12,000 combat aircraft and 2,000 training aircraft in the first six months after M-day. They recommended that the Air Corps finance plant studies which would produce the data needed, and made a strong plea for a peacetime expansion of the Air Corps that would permit the aircraft industry to reach a production level closer to mobilization production requirements.[44]

The enactment of legislation for the expansion of the Air Corps in April 1939 and the subsequent appropriation of funds for the purpose converted quantity production into a real and immediate problem. Although Arnold had directed in April that Air Corps officers dealing with outside agencies express confidence "in the ease and facility of accomplishing the Expansion Program, [and] that our aircraft industry is perfectly capable of producing the 3,000 airplanes needed in the two years time," he apparently had mental reservations of his own. He followed his admonition that "optimism must be the keynote" with a call for another conference of aircraft manufacturers at which he sought assurances to justify his optimism.[45] The meeting, held in Washington early in July at the invitation of Assistant Secretary of War Johnson, was attended by officials of eighteen leading companies representing the major branches of the industry. Arnold presented two questions to this group. First, was the capacity of the aircraft industry sufficient to "absorb the load . . . of the Expansion Program, and at the same time take care of the Navy load, plus the commercial load and any other load that may be put upon it by foreign orders?"[46] Second, what steps had to be taken to expand the existing industry to meet the emergency wartime requirements which might be imposed on it?

The official War Department stand was that the Air Corps must

have its 3,000 planes by 1 July 1941, regardless of other commitments by the industry. Arnold requested the industry to provide him with a yardstick by which the Air Corps could make an objective and reasonably accurate measurement of the productive capacity of the industry without further expansion. Aside from the value of such an instrument for planning purposes, Arnold felt he needed it in order to "show to my superiors that we have every reason to believe that if the allocation of orders is made as we recommend, that the deliveries will be completed inside of two years." The manufacturers were confident of their ability to meet the requirements on schedule and agreed to cooperate with the Materiel Division in providing the desired yardstick.[47] One of some value was eventually formulated by a committee, but events swiftly rendered it obsolete.[48]

The problem of planning an expansion of the industry to meet future emergency requirements was, of course, less susceptible to practical demonstration than was the need for an immediate Air Corps build-up. Discussion centered about means by which the expansion could be accomplished rather than on its size or scope. The larger companies favored expansion of their own facilities rather than subcontracting or the conversion of other facilities, particularly those of the automobile industry, and they opposed the construction of government plants. Arnold told the manufacturers to write their "own ticket," but he left no doubt that the Air Corps would assume its responsibility for adjustment of individual plans to the over-all requirements of the industry and of the War Department.[49] In his report on the conference to the Assistant Secretary he expressed the view that the "greatest accomplishment" had been the "impression made on those representatives of the Industry of their obligation to the Government from a National Defense standpoint."[50] In August, Arnold directed that the Materiel Division secure from all Air Corps contractors factory plans covering the essential elements of production. He called for other studies, including a complete survey of the industry, and stressed the importance of reaching an agreement with the Navy on dividing the productive capacity of the industry between the two services.[51]

The War Department had no aircraft plants of its own, although there had been official proposals in 1937 and again in 1938 for the construction of air arsenals to be used in time of emergency.[52] To have revived these proposals in 1939 probably would have involved polit-

ical difficulties and, in any event, might have served chiefly to render more complex a problem already difficult enough. And so plans proceeded on the assumption that the government would continue to rely upon the traditionally close tie between its Air Corps and the aircraft industry. Some picture of that industry becomes thus a necessary part of any attempt to sketch the over-all problem faced in 1939.

The foundations of the American aircraft industry, somewhat shaky to be sure, were laid in World War I, when the manufacturers delivered 13,894 aircraft and 41,953 engines to the military services between April 1917 and November 1918. By the end of the war the industry had reached a production rate of 21,000 planes per year and employed 175,000 people.[53] Postwar readjustments were severe, and only the strongest companies survived to enjoy the boom years of 1928 and 1929. In the latter year, production exceeded 6,000 planes. Although the Army and Navy continued to be the largest purchasers of aircraft, their volume of purchases was small and the industry had little incentive to standardize its methods in order to achieve mass production. It remained a handwork industry until the enormous demands of 1940–41 forced a conversion to mass-production methods.[54]

For a time in the late 1920's it had appeared that the private and commercial plane market might sustain a swift and phenomenal growth of the industry, but the hope was short-lived; Army and Navy purchases in the amount of approximately $380,000,000 between the fiscal years 1931 and 1939, remained the industry's chief prop. The Air Corps spent $219,000,000 for aircraft during that period, with a range from the $2,000,000 spent in 1934 to the $46,000,000 in 1939.[55] So meager were regular funds for aircraft procurement that the Army and Navy were forced to depend partly on the emergency agencies engaged in public and federal works projects. In 1934–35, the Air Corps bought more than 100 planes with $7,497,612 allotted to it by the Federal Works Agency.*[56] Military expenditures for aircraft mounted after 1935, the Air Corps spending $160,000,000 between fiscal years 1936 and 1939 inclusive, and the Navy, $83,000,000. Foreign and private orders increased also, so that by 1939 the aircraft industry was in the healthiest condition of its recent history, employing approximately 50,000 people.[57]

* The Navy also received funds from this agency for the same purpose.

The aircraft industry in 1939 was the result of a highly competitive process which had permitted the survival of only a relatively few dominant organizations. The limited size of the market, the rapid and expensive technological changes affecting the product, and the strong element of risk had led to consolidations and financial arrangements which left most of the surviving companies in good shape. In general, their current assets exceeded their current liabilities several times over; and the strength of aircraft shares on the stock market, well above the industrial average, reflected the optimistic prospects of the industry. Ranking 41st among the industries of the United States in 1939, with an output valued at almost $280,000,000, the aircraft industry would be transformed by 1944 into the nation's largest industry in terms both of volume of business and earnings. At the end of 1939, the 13 leading companies had a net worth of about $138,000,000 and a total working capital of about $60,000,000.[58] This was about the equivalent of the automobile industry of 1910–11.*

The aircraft industry proper was divided into several major segments—airframes, engines, propellers, and instruments. Other industries, particularly aluminum and rubber, were of great importance in the manufacture of planes, but they were regarded as allied industries and are not included in this discussion. The airframe manufacturer built the airframe shell and performed the task of assembling the component parts into a complete military aircraft, installing the engines, propellers, instruments, tires, and other items which were purchased separately by the Air Corps and sent to the airframe manufacturer. These items and others, including tires and guns, were known as government-furnished equipment (GFE). For some types of planes during World War II (the B-25, for instance) GFE ran to as many as 750 items.

The leading airframe manufacturers were Douglas, Boeing, North American, Lockheed, Glenn L. Martin, Consolidated, and Curtiss

* Sales and net worth of the 13 leading aircraft companies had increased steadily since 1935:

Fiscal Year	*Net Sales*	*Earnings (before taxes)*	*Increase in Net Worth*	*Net Worth Year End*
		(In millions of dollars)		
1935	45	4	–	66
1936	72	7	17	83
1937	117	14	11	94
1938	152	24	17	111
1939	237	44	27	138

Airplane Division, a subsidiary of Curtiss-Wright. Douglas had total sales of $57,000,000 in the three-year period 1936–38. Other companies, particularly Consolidated, Republic, and Glenn L. Martin, were rescued from difficulties only by Army and Navy or foreign purchases during 1938 and 1939. At the end of 1938 the five companies which were to be the leading airframe manufacturers of World War II employed an average of approximately 3,500 people each, as compared with an average of more than 100,000 each in 1943.[59] Two powerful horizontal-type organizations which also manufactured airframes and propellers, United Aircraft and Curtiss-Wright, handled most of the engine business in the United States. Just coming into the field in 1939 was the Allison Division of General Motors, scheduled to play an important role during World War II. A few smaller companies, Ranger and Lycoming, also produced engines, but Pratt & Whitney (a division of United Aircraft) and Wright Aeronautical Corporation virtually monopolized military engine production. In 1938 the engine companies employed less than 9,000 people in contrast with the more than 300,000 employed in 1943. The lucrative propeller market belonged chiefly to Hamilton Standard, a division of United Aircraft, although Curtiss Propeller was beginning to offer some competition in 1939. Kollsman, Pioneer, and Sperry were the chief instrument producers.[60]

The greater part of the industry in 1939 was concentrated along the Atlantic and Pacific seaboards, more than 80 per cent of it within 200 miles of the coasts of the United States. The northeast, traditional center of manufacturing in the United States, had 24.2 per cent of the industry's total airframe floor space, 80.7 per cent of the engine, 81.8 per cent of the propeller, and most of the instrument floor space. The attractions of climate and cheaper costs had brought such large manufacturers as Douglas, Consolidated, and North American to California; thanks to this movement of airframe manufacturers to the west coast in the 1930's, the Pacific area had 45.4 per cent of the airframe floor space but only 4.3 per cent of the engine floor space. The total floor space for the industry, a convenient measurement of production capacity, was 7 to 8 million square feet for airframes, 2.7 million for engines, and 290,000 square feet for propellers.[61] The location of most of the important aircraft plants along our coasts rendered them vulnerable to attack in wartime, particularly from the air, and lent special significance to the problem of locating new facilities.

The over-all production record for the late 1930's was not unim-

pressive in terms of planes produced. From a total of 1,057 planes in 1933, production had mounted to 1,568 in 1935, 2,700 in 1936, over 3,200 in 1937, and more than 3,600 in 1938. The record for 1939 was destined to be the best since 1929—5,856 planes, and this was achieved with an estimated use of only 60 to 75 per cent of productive capacity. But the planes turned out during these years were chiefly private and commercial types, not to be compared with the larger, more powerful, and more complex military aircraft. In 1937 only 949 out of 3,200 planes produced were military types, and in 1939, 2,141 out of 5,856, of which only 560 were delivered to the Air Corps.* Production in 1939 included 3,555 light private planes. Even if all of the resources used in the manufacture of private and commercial planes had been converted to the production of military aircraft, the industry would not have been able to produce enough of them to equal its total production for 1939. In July 1939 General Brett stated flatly that a production rate of 1,000 aircraft per month by M plus 3 was "completely beyond possibilities of realization should M-day occur within the near future."[62] This was true of both airframe and engine manufacturers.

In September 1939 the Air Corps estimated that the aircraft industry as then organized had a potential capacity of 15,000 airplanes per year, while the engine industry had a maximum capacity of 14,000 tactical engines (1,000-horsepower or better). The potential engine deficiency was much greater than a mere matching of the two numbers would indicate, for the trend toward larger and more powerful planes had resulted in the development of many types of two- and four-engine planes—including fighters and transports as well as bombers. The estimated deficiency was 8,680 engines. In order to meet a possible requirement for 40,000 airplanes per year (25,000 more than potential production), the Air Corps estimated that some 20 factories, each capable of producing 1,200 planes annually, would have to be built. Locations recommended were interior industrial cities, with the exception of three plants on the Pacific coast. Expansion of airframe manufacture would have to be matched by expansion of aircraft engine production to more than 80,000 annually. New plants and conversion of part of the automobile industry would have to be the answer to the problem of expansion of engine production. Corresponding increases in production of propellers and other accessories—carburetors, wheels, magnetos—would also be necessary.[63]

* This figure also included planes for the Organized Reserve and the National Guard.

There were expressions of doubt within the Air Corps as to the validity of the estimated potential of the existing industry. The figure of 15,000 aircraft depended upon the industry's adopting a two and one-half shift basis of operations and rested on the assumption that aircraft designs could be frozen to a greater extent than later proved possible. It was also assumed that stocks of GFE, machine tools, and raw materials in good quantity would be on hand, and that an ample supply of labor would be available.[64] War Department planners estimated that the industry could achieve the maximum production rate of 15,000 planes per year nine months after M-day.[65] But in the absence of firm figures as to military requirements over an extended period of time all estimates of productive capacity remained problematical.

The Air Corps and the manufacturers alike agreed that the most constructive step that could be taken would be to increase peacetime production by placing larger military orders. The closer the industry approached its 15,000-plane capacity prior to M-day, the better would be the chance of meeting M-day and post–M-day goals.[66] The 3,000 planes to be built for the Air Corps in 1940 and 1941 plus 1,100 to 1,200 planes for the Navy would help, but these figures still fell short of potential capacity, and the industry would have no assurance of continuing orders after fiscal year 1941 except for small replacement orders. Accordingly, there was little incentive for expansion in response to American military procurement alone, except temporarily in order to meet contractual obligations.[67]

The disastrous consequences of the overexpansion of the late 1920's and the constricting influence of the depression years had left the aircraft manufacturers with a disinclination to expand their plant facilities at their own expense. Additions were made only when absolutely necessary and frequently were paid for out of operating profits. In spite of the rapid growth of the business after 1935 very few manufacturers enlarged their plants until 1939, when a number of companies undertook limited expansions, chiefly on the strength of foreign military orders. Among those which increased their floor space, either by construction or by lease, were Pratt & Whitney, Lockheed, Glenn L. Martin, Wright Aeronautical, Boeing, North American, and Douglas. It was estimated that during the first six months of 1939 manufacturing area in the airframe plants was increased by 17 per cent and in engine plants by 20 per cent.[68] Possibly the most com-

pelling reason for the expansion which began at this time was the need to meet delivery dates, particularly for the Army and Navy, and to take care of additional foreign orders which were anticipated. Since this production could not be stretched over a long period of time, some additional space was needed, at least for the life of the contracts. Increased subcontracting was necessary, but some manufacturers preferred to use their own facilities as much as possible and undertook the expansions indicated.[69]

The British Royal Air Force and the French Air Force played a major part during 1938 and 1939 in increasing the actual and potential production of the American aircraft industry. These air forces, already aware in 1938 that they were losing the race for air superiority to the Luftwaffe, turned to the United States for the additional production which would help them overtake the Germans. Orders placed in 1938 and down to September 1939 totaled some 1,600 aircraft, chiefly bombers, pursuit planes, and trainers. The embargo placed on munitions exports by invocation of the Neutrality Act at the outbreak of war early in September was raised in November, and the British and French, spurred on by the actuality of war, increased greatly their American orders. It is estimated that foreign orders accounted for some $400,000,000 of the $680,000,000 backlog of orders at the end of 1939. The aircraft industry received higher prices for and made larger profits from the sale of military aircraft to foreign air forces than to our own military services and hence were receptive to orders from abroad.[70] From the long-range viewpoint, of greatest significance for the United States was the willingness of foreign countries to pay for the plant expansion which was considered necessary in order to meet their orders on time. It is accurate to say, then, that the initial expansion of the American aircraft industry in 1939–40, and one which was of great benefit to the country, was paid for by Great Britain and France.

The export business had always been of importance to the American aircraft industry, averaging about 15 per cent of its total production in the late 1930's. In dollar value it was even more important, for most of the planes exported were the more expensive military and commercial planes rather than the small private planes—and the profit margin was generally higher on planes for foreign purchasers. Since the reluctance of the Air Corps and the Navy to permit sale abroad of current production types of military aircraft had limited their

market, a number of manufacturers had urged the military services during 1938 and 1939 to lift this restriction, arguing that the benefits to the country would be greater than any loss. They pointed out that larger orders would lead to increased production and possibly to expanded capacity. As for giving away military secrets, the United States would still control the flow of spare parts, and continued operation of the planes by foreign powers would be impossible without the parts.[71] Arnold, convinced of the overriding importance of increasing production and hopeful of getting for the government a lower unit price as a result, recommended in August 1939 the release for export of "aircraft and aircraft equipment in a production status, with the exception of bombsights, fire control, navigational and similar equipment. . . ." The President approved the recommendation on 8 August.[72] In time, this decision would present critical questions involving the interests of the RAF and a rapidly expanding AAF, but there can be no doubt as to the ultimate advantage of the boost thus given to the productive capacity of the American aircraft industry.

CHAPTER 6

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AAF AIRCRAFT OF WORLD WAR II

THE AAF fought during World War II with aircraft which were all either in production or under development prior to 7 December 1941. An unavoidable time lag exists between the conception of a weapon and its tactical use, and this is particularly true of such a complex machine as the modern combat plane. Despite intensive efforts during the war to shorten the interval, the lag was rarely less than three and often as much as five or more years. The major wartime achievements in research and development—for example, jet propulsion—had their chief effect on the tactical strength of the air force only after the war was over. But if the AAF necessarily fought with prewar types of aircraft, a multitude of modifications made the AAF's 1945 planes far superior to their 1941 and 1942 predecessors.

The more highly publicized planes, such as the B-17 and the P-47, became familiar to the American public according to a conventional mode of designation that combined a letter as the symbol of function with a numeral to indicate sequence within a type. In these designations, A stood for Attack, B for Bombardment, C for Cargo (transport), F for Photographic, L for Liaison, P for Pursuit (fighter), and T for Training (the prefix of P, B, or A indicated Primary, Basic, and Advanced). The men who flew in combat, and who thus knew at first hand the desperate need to counter each tactical or technical advance by the enemy, gave closer attention to the letter appended after the numeral to indicate the model, for the B-17E incorporated improvements over the earlier B-17D. Only as a plane reached the state of obsolescence did the AAF leave off in a continuing effort to improve its performance and its equipment.

In the development of improved equipment the primary responsi-

bility might lie in agencies outside the AAF. The application of radar to problems of navigation and target identification undoubtedly represented the most significant advance of the war years, but for the development of radar devices of all sorts the AAF looked to the Signal Corps until late in 1944. Similarly, the Ordnance Department of the Army carried the responsibility for armament employed in aircraft—a field in which the chief progress during the war came in the use of guns of heavier caliber and in larger numbers. Although an armament conference of Air Corps leaders meeting in December 1939 had emphasized the need for development of weapons specifically designed for use in the airplane, the AAF in 1941 was still basically dependent, bombs alone excepted, upon adaptations of weapons originally designed for ground or naval use.[1] Of these the .50-caliber machine gun ranked first in importance. But if responsibility in significant areas of development was thus divided, there was no division in so far as the airplane itself was concerned. For the airframe, for its armor, and for its motive force, and for such developments as the power-driven turret and a central control of firepower, the responsibility was clearly fixed within the AAF.

The military aircraft of World War II was a monoplane with one to four engines and an aluminum airframe housing a mass of equipment for the purposes of navigation, armament, communication, and crew accommodation. The power plant and its accompanying propeller were the keys to aircraft performance, for speed, range, altitude, and rate of climb depended in large measure on the power and efficiency of the propulsion unit. The race to increase the power ratings of existing engines and to develop new ones was among the most significant competitions of the war.*

World War II aircraft were powered by multicylinder, reciprocat-

* The improvement achieved is suggested by the following table:

Engines	*Original Take-off Horsepower Rating*	*1945 Take-off Horsepower Rating*
Packard V-1650	1,300	1,700
Allison V-1710	1,000	1,700
Wright R-1820	750	1,350
Pratt & Whitney R-1830	950	1,350
Wright R-2600	1,500	1,800
Pratt & Whitney R-2800	1,800	2,100
Wright R-3350	1,800	2,500

The maximum horsepower actually in use in 1945 was somewhat lower than shown above because the engines with the 1945 take-off ratings were usually not yet incorporated in combat models.

ing engines. Heavier planes which required more powerful engines became still heavier with the installation of larger engines. In the effort to secure maximum power with a minimum weight, engines, like the planes they served, went through many changes. The Pratt & Whitney R-1830 engine* went through six major and some eighteen minor variations, making a total of twenty-four models, none of them completely interchangeable.[2] Although the P-35 and P-36, standard fighters of the late 1930's, had been powered by air-cooled radial engines, the P-38, P-39, P-40, P-47, and P-51 were all originally designed around the liquid-cooled in-line or V-type engine.[3] The liquid-cooled engine was more compact than the air-cooled radial engine, and it had a larger horsepower output per unit of frontal area, an important consideration in aircraft design.† In addition, liquid-cooled engines consumed fuel more efficiently than did air-cooled ones.[4]

Two developments perfected during the 1930's—the supercharger and the controllable-pitch constant-speed propeller—played important parts in increasing the efficiency of the aircraft engine. The controllable-pitch constant-speed propeller could be set to maintain any chosen engine speed and thereby permitted maximum utilization of available engine power under all conditions. The supercharger, a device for increasing the mass air charge of an internal combustion engine over that which would normally be drawn in by the pistons, is used to compensate for the lower density of air at high altitudes. It was the supercharger, either as an integral part of or as a separate unit attached to increasingly powerful engines, which permitted the

* The AAF designated its engines thus by letter and number—the letter R indicating a radial arrangement of the cylinders, the letter V an in-line V-type arrangement. The number was fixed by the cubic-inch piston displacement.

† The only American manufacturer of liquid-cooled engines for military purposes in 1939 was the Allison Division of General Motors, which was just bringing its V-1710 engine into production. The success of the British with the Rolls Royce Merlin engine and the obvious desirability of having another source of production persuaded the Air Corps to initiate production of the Merlin engine in the United States in 1940. The Packard Motor Car Company manufactured the engine as the V-1650, beginning in 1941, after an "extraordinarily rapid and excellent job of redrawing the engine to conform to American production standards and practices." But because the air-cooled engine had certain advantages over the liquid-cooled one, including less vulnerability, more durability, and easier maintenance, the Air Corps did not rule out its use in fighter planes. The development of the R-2800 engine (used with great success in the P-47) by Pratt & Whitney provided an outstanding air-cooled engine with a potential great enough eventually to make it at least the equal in performance of any liquid-cooled engine.

operation of AAF bombers and fighters at greater speeds and higher altitudes.

By the end of hostilities all heavy bombers had achieved a ceiling of more than 30,000 feet and that of the B-29 approached 40,000. Similarly, speed had been increased and range extended. The 300 miles per hour maximum and 600 miles combat range of the P-36 in 1939 contrasted sharply with the almost 500 miles per hour of the P-51H and the better than 2,000-mile range of the P-47N in 1945. In 1939 the B-17B was credited with a high speed of 268 miles per hour and a combat range of 1,000 miles. In 1945 the B-29B, more than twice as large as the B-17B, had a top speed of almost 400 miles per hour and a combat range approaching 4,000 miles.[5] The intervening years, whatever the failures may have been, had been nevertheless years of startling achievement.

It is difficult to draw a satisfactory line between the most general description of a plane and detailed tabulation of specific models. The difficulty becomes the greater because so much of the critical data on performance acquires practical meaning only when considered in relation to the varied requirements of combat. Performance characteristics are generally given in terms of maximum capabilities under ideal conditions and can be misleading as to performance under battle conditions. An aircraft may have a top speed of 300 miles per hour, a ceiling of 30,000 feet, a maximum or ferrying range of 3,000 miles, and a maximum bomb load of 8,000 pounds, but it cannot achieve all of these maximums in a single flight, even under ideal conditions. In order to fly 3,000 miles, it must carry a maximum fuel load and no bombs, and it must cruise at a moderate rate of speed to conserve fuel. The effective range under battle conditions, for example, thus becomes something quite different from the full potential considered without reference to military obligations. Statistics of maximum performance in the several categories nevertheless offer useful guidance as to the relative potential of different planes for any type of employment.*

* It may be helpful for the reader to bear in mind the following definitions. The *range* of a plane is the total distance it can fly without refueling. Its *maximum range* is a ferrying range, which is to say that the additional range is secured by using all available space for added fuel. The *combat range* is necessarily somewhat less than the maximum range because the plane is combat-loaded—that is, it carries bombs and other items required for combat in lieu of additional fuel. The *tactical radius* of a plane is the maximum distance it can fly away from its base with a normal combat load and return without refueling, allowing for all safety and operating factors. For practical

All told, the AAF employed more than a hundred aircraft models during World War II. At its peak strength in July 1944, it had on hand 79,908 planes of all types.[6] In the following pages the more important of these planes will be discussed in terms of their conventional classification.

Attack and Bombardment

Although opinion in the AAF placed special stress on strategic bombardment as the prime mission of an air force, the dominant view in the War Department General Staff was officially stated as late as October 1938 in these terms: "the Infantry Division continues to be the basic combat element by which battles are won, the necessary enemy field forces destroyed, and captured territory held."[7] It followed that the primary function of Army aviation was the support of ground forces in battle. And from this emphasis came the influences which gave shape to the A-20, the A-26, and the more famous B-25 and B-26, all of them designed basically for a supporting mission.

The attack plane, first so designated in 1922 and frequently described as a light bomber, was designed for immediate support of ground troops. Because it was to operate chiefly at low altitude, a premium was placed on high speed and maneuverability. Armed with bombs and machine guns, its development during the war years tended to carry the plane closer to the classification of the medium bomber, especially after fighter aircraft proved particularly effective in the combined functions of a fighter-bomber. The medium bomber, considered to be a "pure bombardment type," was intended to operate at medium altitudes of 8,000 to 14,000 feet and primarily against depots, fortified positions, railroad yards, and other such targets along or behind the battle line.[8] Carrying a heavier bomb load and enjoying the advantage of greater range, the mediums could supplement the work of light bombers and might assist the long-range heavy bombers against the nearer targets in a strategic bombardment effort.

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purposes during World War II, tactical radius was considered to be three-eighths to two-fifths of the combat range. These figures were considerably less than half the combat range because of allowances for certain factors—including fuel reserves, time required for assembly of formations, and time in the combat zone—which were not included in the computation of combat range. Both combat range and tactical radius vary with the loading of the plane.

The *A-20,* or the Havoc, was developed from the Douglas DB-7, originally designed for the French Air Force in 1937. Its prototype was test-flown in 1938; production began the next year; and during 1940 the Air Corps accepted almost 300 A-20's, most of them for release to the British, who called the planes Bostons and put them to good use in North Africa.[9] The AAF used the A-20 in most theaters of operations during the war, and had a peak inventory of more than 1,700 of the planes in September 1944, but of the 7,385 A-20's accepted between 1940 and 1944, a substantial number were allocated to the British and the Russians.[10] Production of A-20's was discontinued late in 1944, when the superior A-26 became available in sufficient numbers to begin replacement of the A-20 in combat units.[11]

The A-20, of which there were eight major models, was a mid-wing all-metal monoplane powered by two Wright R-2600 engines. With improved engines, the airframe weight of the plane increased from 8,600 pounds in 1941 to 10,800 pounds in 1944, while the maximum weight (including bombs and crew) increased from some 21,000 pounds to 30,000 pounds. The armament was also increased —from seven .30-caliber machine guns in 1941 to as many as nine .50-caliber machine guns in 1944–45. Some of the later A-20's carried five .50-caliber machine guns and up to twelve 5-inch rockets. The bomb load was increased from a maximum of 2,400 pounds in 1941 to 4,000 pounds in 1944–45, carried both internally and externally. There was little increase in the maximum speed (325 miles per hour) or the tactical radius of the A-20 during the war, largely because of the increase in weight without a proportional increase in engine power. The normal tactical radius with 2,000 pounds of bombs was 250 miles.[12] It carried a three-man crew.

The early success of the German Stuka led AAF leaders to consider redesigning the A-20 as a dive bomber, but the technical difficulties proved to be too great. Efforts to convert Navy dive bombers to meet Air Corps needs were then pushed, but when the chief product of these efforts, the single-engine *A-24* (Navy SBD-3), was combat-tested in New Guinea, it was considered by Army airmen to be too slow, too limited in range, and too vulnerable to enemy fighters.[13] In the spring of 1942 it was decided that the P-51, a new fighter that had gone into production the preceding year and for which the AAF as yet had no major plans, could be converted

into a dive bomber. With added diving brakes* and external wing bomb racks carrying up to 1,000 pounds, and with changes of armament and engine, the modified P-51 became the *A-36*.[14] By early 1943 two groups had been equipped for service in the Mediterranean, where they performed well enough but where experience also demonstrated that the value of this specialized plane had been overestimated. The more versatile fighter-bomber—a straight fighter equipped with bomb racks—proved much more useful. By V-J Day the A-36 had completely disappeared from AAF inventories.[15]

The *B-25* (Mitchell) and the *B-26* (Marauder), each operating with six-man crews, served as the AAF's medium bombers during the greater part of World War II. North American had initiated design on the B-25 in February 1938 and production began in February 1941, without benefit of an experimental prototype plane.[16] Similarly, the Air Corps bought the B-26 from the Glenn L. Martin Company right off the drawing board in 1939: a production contract was signed in September of that year, the first plane flew in November 1940, and manufacture got under way at approximately the same time as that of the B-25.[17] Since the Mitchell was being produced in quantity at an earlier date, it was the first to reach the combat areas in substantial numbers.[18] After its use on Doolittle's Tokyo raid in the spring of 1942, only the highly publicized B-17 was better known to the American public. In all, the AAF accepted 9,816 B-25's and 5,157 B-26's; a large number of the B-25's accepted were intended for British and Russian use. The peak AAF inventory for the B-25 was 2,656 in July 1944, and for the B-26, 1,931 in March 1944. After January 1944 B-25 and B-26 groups within the AAF were approximately equal in number. B-26 production ceased in April 1945 and B-25 production came to an end shortly after V-J Day.[19]

Both planes were twin-engine all-metal midwing monoplanes. In 1941 the Mitchell's two R-2600 engines gave it a maximum take-off power rating of 3,400 horsepower as compared with the Marauder's 3,700. In 1945 the rating for the Mitchell had not been increased, but that of the Marauder had been stepped up to 4,000. During the same period the airframe weight of the B-25 was increased from 11,600 pounds to 13,000 pounds and the maximum weight from

* Apparently the brakes were not satisfactory, for they were wired shut and all dives were made without brakes.

25,000 to 35,000 pounds. The Marauder, a larger plane to begin with, grew from an original airframe weight of 14,100 pounds to almost 17,000 pounds, while its maximum went from 33,000 pounds to more than 38,000. The five machine guns mounted on the 1941 models of the two planes were increased to as many as fourteen .50-caliber guns on some B-25's and twelve on the other plane. Some of the B-25's were equipped with a 75-mm. cannon in the nose of the plane in addition to a half-dozen machine guns. The B-26 was the first American bomber designed with a gun turret, and the B-25 had turrets incorporated, beginning with the B-25B. Normal bomb loads were about 2,400 pounds in 1941 and 4,000 pounds in 1945.[20] As with the A-20, the speeds of the B-25 and B-26 were not measurably increased during the war. The maximum speed for the B-25 at normal combat weight in 1945 (33,500 pounds) was 285 miles per hour, and for the B-26 (at 37,000 pounds) it was about the same. Because of the considerable differences in total weight and in bomb loads carried, it is difficult to compare accurately the 1941 and 1945 ranges of these planes. By 1945 the combat range of the B-25 with a 3,200-pound bomb load was 1,200 miles and for the B-26 with a 4,000-pound load, 1,100 miles.[21] The significant factor in medium bombardment operations, it might be noted, is the size of the bomb load and not the range.

The B-25 ranked consistently as a favorite among AAF pilots, but the B-26 was promptly dubbed the "Widow Maker" and the "Flying Prostitute." Trouble experienced from the first delivery of the plane early in 1941 so persisted that only one combat group (the 22d Bombardment Group, soon sent to Australia) had been equipped with the B-26 by December of that year.[22] As accidents, some of them fatal, continued, General Arnold at the end of March 1942 appointed a special investigating board headed by Maj. Gen. Carl Spaatz to determine whether production should be continued. The board recommended several changes in the plane's design (the chief being a larger wing) and continued use of the plane.[23] Manufacture of the B-26, which had been suspended until necessary changes had been made, was resumed in May, but in July and once again in October 1942 the AAF gave serious consideration to scrapping the B-26 in favor of some other type of plane.[24] But Maj. Gen. George C. Kenney, on the basis of experience in SWPA, commended the plane to Arnold,[25] and before the end of the year B-26 units were

operating successfully in North Africa. After tripping over one final hurdle, a tragic miscarriage of one of the earliest B-26 missions from England that led to further discussion of abandoning the plane,[26] the B-26 won full approval. A "hot" plane with a fast landing speed, it more than proved its worth after experience and intensified training taught pilots how to handle it.

Despite its designation, the *A-26* (Invader), which first appeared in combat in 1944, was the most advanced medium bomber used by the AAF during the war. Douglas began designing the plane in January 1941, building the new model on the best features of the DB-7 and the A-20 but with plans for a much greater range and bomb load. Flown first in July 1942, the A-26 went into production in September 1943. By May 1945 six A-26 groups had been committed in overseas theaters. Acceptances of the plane reached almost 2,500 by August 1945.[27]

The Invader was an all-metal midwing monoplane powered by two Pratt & Whitney R-2800 engines, the same power plant used in the B-26. With a combat weight of 35,000 pounds, the A-26 could fly at 360 miles per hour, more than 60 miles faster than the other medium bombers. Its combat range reached 1,000 miles, with a bomb load of 4,000 pounds and a three-man crew. Formidably armed with eighteen .50-caliber machine guns and fourteen 5-inch rockets, the plane had a maximum bomb load of 6,000 pounds, two-thirds of it carried internally.[28]

As early as 1942 the AAF planned to replace all other mediums with the A-26.* But production delays, for which AAF Headquarters was inclined to blame the Douglas Company, kept acceptances to a total of only twenty-one planes by 1 March 1944. Arnold's insistence that he wanted the plane "for use in this war and not for the next war" helped to overcome certain shortages of machine tools, and after July 1944 production mounted steadily.[29] Though a late comer, the A-26 compiled a distinguished combat record and, after a period of uncertainty in 1944, won ready acceptance from the crews who flew it. In the postwar period, the A-26 became the Air Force's standard tactical bomber. Redesignated as the B-26 in 1947, it was to be heavily relied on three years later in Korea.

* Experiments were also made to test the possibility that a converted version of the plane might do as a night fighter.

The Big Bomber

Interest among American airmen in the development of a "big bomber" extended back to the early 1920's. Plans for a night bomber with a cruising radius up to 1,000 miles, and a payload of 10,000 pounds, had led in 1923 to the Barling bomber—the largest plane built in the United States up to that time. A triplane with a gross weight of more than 42,000 pounds, its six Liberty 12-A engines proved unequal to the task of achieving a speed even of 100 miles per hour; nor could they lift the plane across the Appalachians for the 400-mile flight from Dayton to Washington. But the venture provided useful engineering data, emphasizing especially the ratio that must be observed between the size of a plane and the power generated by its engines.[30] For the remainder of the decade nothing more ambitious than a twin-engine plane was attempted. By the 1930's, however, great progress had been made in the field of aerodynamics and improvements of design had brought the monoplane with its many advantages. Public policy, moreover, opened the way between 1931 and 1935 for the Air Corps to undertake responsibilities of coastal defense that would justify the development of a long-range bomber.

The planners showed some tendency, again, to get ahead of the engineers. The Materiel Division in 1933 set the objective in terms of a plane with a range of 5,000 miles at a speed of 200 miles per hour with a bomb load of 2,000 pounds. War Department approval having given the development plan official status as Project A, contracts of 1934 and 1935 with Boeing resulted in the construction of one experimental model, completed in the fall of 1937 as the XB-15.* Its gross weight of 70,000 pounds was too great for its four 1,000-horsepower engines; its top speed of 190 miles per hour was less than had been hoped for, and its high fuel consumption did not permit it to approach the range projected for it. An Air Corps proposal to modify the plane and produce a model called the YB-20† was disapproved by the Assistant Secretary of War.[31] Another contract of 1935, this time with the Douglas Aircraft Company, produced in June 1941 the XB-19—the largest of all bombers prior to the B-36. Neither the four 2,200-horsepower motors originally installed

* See Vol. I, 65–66.

† The prefix Y indicated planes intended for service testing.

nor the four of 2,600 horsepower each subsequently tried provided the lift required by its 160,000 pounds maximum gross weight.[32] The B-19, like the B-15, served only to test, and thus to advance, the engineering knowledge that went into the construction of other and more successful planes.

The *B-17*, built by Boeing to less ambitious specifications submitted in a design competition for a multiengine bomber in 1933-34, was the first of the Air Corps' "big bombers." Flown originally in July 1935, the plane had a gross weight of 40,000 pounds and four 750-horsepower engines. The tragic loss, through crash and burning, of the first model in the fall of 1935 forced the Air Corps, which had been much impressed by the plane's performance, to reduce a planned purchase of sixty-five of the aircraft to only thirteen, all of which had been delivered by August 1937.[33]

Convinced that it had in the B-17 the best bomber in the world, the Air Corps was anxious to purchase the plane in quantity for equipment of the GHQ Air Force. Procurement estimates for fiscal year 1938, submitted to the War Department in 1936, recommended the establishment of at least two B-17 groups—one to be stationed on the east coast and one on the west. Place should be found in the 1938 budget for fifty B-17's, in supplement to the twenty-six already authorized for 1937, and for eleven Project A planes as tokens of a policy of continuing development and production. But a special study by G-4, prepared at the request of the Secretary of War, brought in June 1936 a most discouraging statement of War Department policy.[34] Concentration on the big bomber, an offensive weapon, was inconsistent with national policy and threatened unnecessary duplication of function with the Navy, whose eleven carrier-based bombing squadrons equaled the combined total of such forces elsewhere in the world. No country had at the time, or was likely to have in the near future, aircraft capable of mounting an air attack on the United States. And since aircraft of medium range were "capable of attacking" any hostile naval or land-based aviation within effective range of our vital strategic areas, the request for the much more expensive long-range planes lacked logic. The B-18, then the standard two-engine bomber, was equal to any mission assigned the Air Corps and was much less expensive. Not only did the study advise against the purchase of the requested B-17's but, in a reversal of the attitude more recently governing policy, the paper argued

against the development of "long-range, high-cost, bombardment airplanes" of the Project A type. Until the international situation indicated a "need for long-range bombardment aviation," the Air Corps should be equipped with "airplanes of reasonable performances rather than to have nothing as a result of our efforts to reach for the ideal."

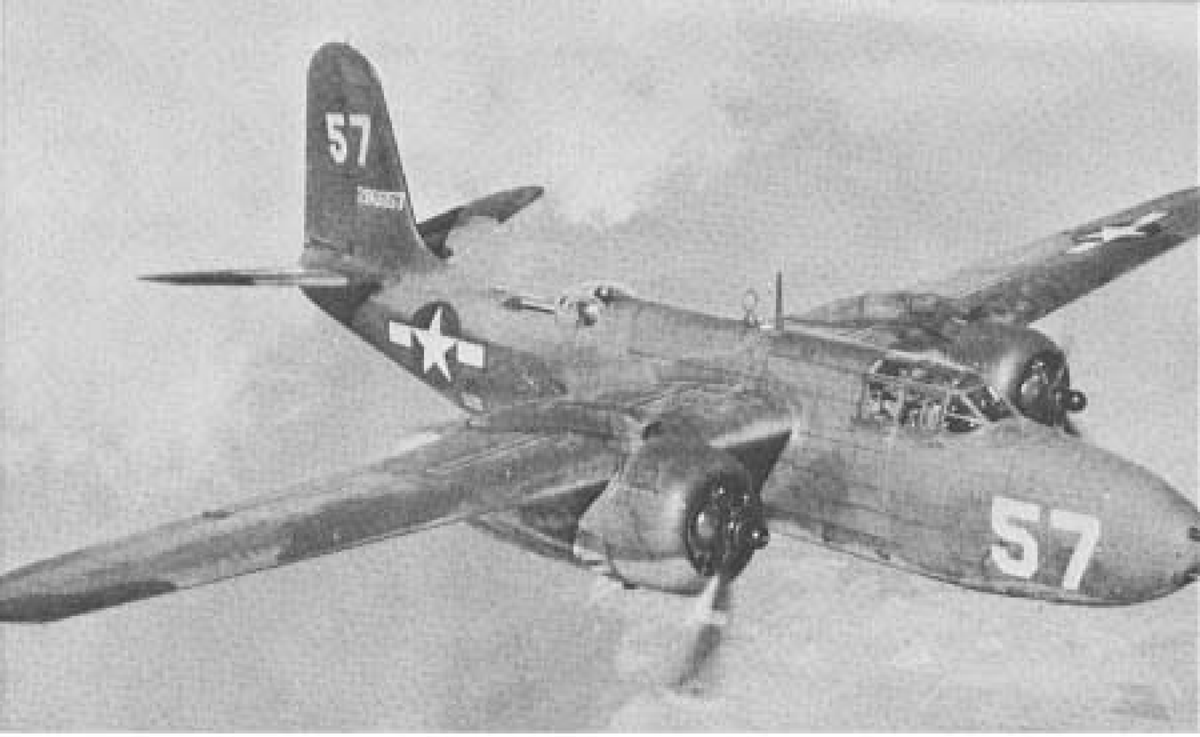
These views as to Army aircraft requirements were to prevail against Air Corps arguments until the logic of events destroyed the assumptions on which the analysis was based. When President Roosevelt added the weight of his own insistence upon a greatly expanded program of aircraft production in the autumn of 1938,* the Air Corps' only long-range bombers were the original thirteen B-17's. An early addition to bomber strength was promised by a total of forty aircraft on order at the end of that year.[35] General Andrews, commanding the GHQ Air Force, had recommended in 1937 that his bombardment units henceforth should be equipped only with four-engine bombers,[36] but that force would not begin to be equipped with the B-17 until the summer of 1939.[37] During the calendar year of 1940 factory acceptances of heavy bombers totaled 60 aircraft (53 B-17's and 7 B-24's); for 1941 the total reached 313 (144 B-17's and 169 B-24's).[38] At the opening of hostilities in December of that year, official figures for heavy bombers on hand in the AAF were just under 300.[39]

Although the Air Corps by 1938 had won approval of the B-17 as a standard model for use in combat units, the War Department as late as October of that year specified that production of four-engine bombers should not be included in estimates for fiscal 1940 and 1941.[40] Also, in response to a request for funds to underwrite the development of a pressurized-cabin bomber with a ceiling of 30,000 feet and a range of 4,000 miles, the War Department had replied in August 1938 that "experimentation and development for fiscal years 1939 and 1940 will be restricted to that class of aviation designed for the close support of ground troops. . . ."[41] But the President's newly awakened interest in aviation soon removed all such barriers to the attainment of Air Corps hopes. Valuable time had been lost, but the experimental models of the B-17 already gave proof that the day of the big bomber had come.

The delay in getting the plane into quantity production must be

* See above, pp. 9–10.

A-24 DOUGLAS DAUNTLESS



A-20 DOUGLAS HAVOC

A-26 DOUGLAS INVADER

attributed in part to continuing experimentation for the improvement of its performance. Series A, B, C, and D all predated Pearl Harbor—the planes which carried destruction to Germany were B-17E's, F's, and G's, and chiefly the last two. The B-17B, the first assigned to combat units, had an airframe weight of 18,700 pounds, a maximum gross weight well in excess of 40,000 pounds, and could carry a maximum bomb load of 8,800 pounds—which it rarely did. Powered by four Wright R-1820-51 engines of 1,000 horsepower each, the plane had a maximum speed of 268 miles an hour and a cruising speed of 230 miles per hour at an altitude of 25,000 feet; at 10,000 feet the speeds were 233 and 176 respectively. Obviously, operation at high altitudes was extremely important if maximum speed was to be obtained, not to mention the additional encouragement to raise the ceiling subsequently provided by enemy fighter planes and antiaircraft. The B-17B had a maximum range of 3,000 miles, but its combat range with a bomb load of 2,400 pounds was less than 1,500 miles.* This meant a radius of little more than 600 miles. For armament the plane carried only five flexible machine guns, all of them .30-caliber initially—hardly enough to justify its popular designation as the Flying Fortress.[42]

The installation of superchargers on the B-17B raised the ceiling 10,000 feet over that of the original 1935 model. Further refinements of supercharger and engine (the horsepower reached 1,200 during the course of the war) gave the B-17G in 1945 an operating ceiling of more than 30,000 feet and a top speed of some 300 miles per hour.[43] The problem of increasing range without sacrificing bomb load continued to challenge the attention of engineers and combat leaders alike. From the early B-17's of 1939 to the B-17F and G, the fuel capacity was more than doubled—from 1,700 gallons† to more than 3,600 gallons. This doubling of fuel capacity could not result in a comparable extension of range, for the fuel and other changes added their own weight to the load that must be carried, but the radius of action was markedly extended. While the B-17C and D were credited with a range of 1,280 miles carrying a bomb load of 2,400 pounds, the B-17F and G, with a bomb load of 4,000

* Prewar statistics on range of aircraft were generally found to be exaggerated when actual wartime experience brought home to the AAF the great host of factors affecting combat radius of action.

† In 1941 the B-17B's had a maximum fuel capacity of almost 2,500 gallons.

pounds, had a combat range of better than 2,000 miles.[44] The B-17B carried two .30-caliber and three .50-caliber machine guns in 1941; in 1945 the B-17F and G carried twelve .50-caliber machine guns, four of them housed in upper and lower power-driven turrets, features not found in the earlier models. Other additions included protective armor, bullet-proof windshields, and various types of equipment for communication, navigation, and flight control. The bomb loading depended on the type of bomb carried—the B-17F and G could carry only two 2,000-pound bombs, but there was room for eight 1,600-pound or 1,000-pound bombs. The quantity of smaller bombs that could be loaded varied.[45]

A typical mission by B-17's in the European theater in 1944–45 would take them to Berlin, Munich, or Leipzig. From their airfields in East Anglia the bombers would have a practical radius of some 600 to 700 miles with a bomb load of 4,000 to 5,000 pounds. Longer missions were occasionally flown to targets like Danzig and Warsaw, but these were with reduced bomb loads. For most combat purposes then, the effective combat radius of the B-17 may be stated as less than 800 miles.[46]

The B-17, although the first of the country's heavy bombers, was not produced in as great quantity as was the B-24. Between January 1940 and 31 August 1945 the AAF accepted a total of 12,692 B-17's and 18,190 B-24's.* The peak AAF inventory for B-17's was 4,574 in August 1944, and for B-24's, 6,043 in September 1944.[47] The maximum number of overseas combat groups was thirty-three for the B-17 in September 1944 and forty-five and one-half for the B-24 in June 1944. Both planes were used in virtually every theater of war, but, in general, the B-17's were concentrated in the European and Mediterranean theaters and the B-24's in the Mediterranean and Pacific theaters.[48]

The *B-24* represented one of the earliest products of President Roosevelt's intervention in behalf of air power in the autumn of 1938. Taking advantage of the new authority for heavy bomber development, General Arnold in January 1939 asked the Consolidated Aircraft Company to produce a four-engine bomber with a 3,000-mile range, a top speed above 300 miles per hour, and a ceiling of 35,000 feet. These specifications exceeded current B-17

* Of these last, a large number went to Allied countries, and the Navy took nearly 1,000 (see Vol. I, 551*n*).

characteristics, and it was hoped that a superior plane might be the result. On the basis of preliminary engineering data, the Air Corps contracted in March 1939 for a prototype to be produced by the end of that year.[49] Drawing heavily upon experience with the B-15 and the B-17, Consolidated had the new plane ready for its first test-flight at San Diego in December. Already the Air Corps, losing no chance to speed its preparation for war, had contracted for seven YB-24's and thirty-six B-24A's.[50] The plane went into production in 1941.

Like the B-17, the B-24 underwent many modifications. Production models actually reached the B-24M, and model N was under development at the close of the war. Quantity production came with model D, and on the battle fronts D, H, and J became the most familiar. The B-24D carried the turbosupercharger. Additional armor, self-sealing fuel tanks, power-operated gun turrets, and improved flight equipment may be listed among the major changes. Ten .50-caliber machine guns replaced the original three .50-caliber and four .30-caliber guns. The maximum bomb load rose from 8,800 pounds to 12,800.[51] The speed remained comparable to that of the B-17.

The most distinctive feature of the B-24 was its twin-tail construction. As early as 1942 the AAF felt that a single-tail B-24 would provide greater stability, and Consolidated undertook to try the change. Test models flown in 1943 produced results that led in April 1944 to a decision that all future B-24's would have the single tail.[52] Actually, the Navy got most of the newly designed Liberators,* and on Army fields the familiar twin-tail remained the distinguishing feature of the B-24. An ungainly looking ship on the ground, it had a grace of its own in the air. The number of B-24's produced during the war years, which reached a higher figure than that for any other U.S. combat aircraft, testifies to the plane's continuing utility in a wide variety of roles, including those of tanker and transport as well as bomber.

The B-17 and the B-24 inevitably invited comparison. Coming along four to five years after the B-17, the B-24 possessed an initial advantage. It carried a larger bomb load than the B-17 and could carry the load farther with a crew of the same size—ten men. Listed in the charts originally as having a range of 2,850 miles with a 2,500-pound bomb load, experience showed that it did have a longer reach than any other competing plane.[53] It was this advantage that gave the

* Called Privateers or PB4Y2's.

B-24 the call over the B-17 for service in CBI and SWPA, where Kenney's Fifth Air Force used it for the 2,400-mile round trip attacks on Balikpapan in 1944,* and where regularly, if less spectacularly, it extended the coverage of overwater search. Against the German Air Force, however, combat experience showed the plane to be lacking in armament and armor. Attempts to remedy these and other shortcomings increased the weight of the plane and altered flight characteristics in such a way as to render it less stable. Lt. Gen. James H. Doolittle, commanding the Eighth Air Force, made his preference for the B-17 clear in a letter of January 1945.[54] By that date the increased range of the B-17 some time since had robbed the B-24 of its chief advantage.[55] Against the Luftwaffe, the capital enemy, the rugged and steady B-17 remained the natural pick.

The *B-29*, whose size and performance justified its classification as a Very Heavy (VHB) or Very Long-Range (VLR) bomber, was the largest bombardment plane employed by any belligerent during World War II. Flying first from China and later from the Marianas, the plane repeatedly proved its capacity to deliver payloads up to 15,000 pounds against Japanese targets at a distance of as much as 1,600 statute miles from base. The story of the plane, and of the tactical and technical changes which made this achievement possible, has been recounted in an earlier volume of this series.† Here it will be sufficient to summarize somewhat briefly for the convenience of the reader.

Having acted to assure the necessary provision of bombardment planes built to more modest specifications, the AAF turned its attention to the realization of a goal as old as Project A‡—the building of a really big bomber. Practical experience argued against any attempt to take too high a hurdle at once, and the original specifications submitted to manufacturers in January 1940 were below those for the as yet unfinished B-19. Contracts for experimental models were completed with Boeing and Consolidated on 6 September 1940, the projected models receiving designations, respectively, as the XB-29 and the XB-32.[56] Both planes were test-flown for the first time in September

* See Vol. V, 316–22. In the war against Germany, the plane's most famous mission was that flown from Africa against Ploesti in August 1943 (see Vol. II, 477–84).

† In Vol. V, Sections I and IV. See especially Chap. 1 for the origins of the VLR project.

‡ See above, p. 202.

1942, but successive delays in getting the B-32 into production gave it an insignificant place in the combat history of the war.* In contrast, though there were discouraging delays, the B-29 set a remarkable combat record within four years of the original experimental contract. Boeing made the first delivery, of seven planes, in July 1943. By the end of August 1945 acceptances had reached a total of 3,763. AAF inventories that month showed 2,132 of the aircraft on hand, of which number over 1,000 then belonged to the Marianas-based Twentieth Air Force. At the end of the war forty B-29 groups had been organized, and of these twenty-one had reached their combat stations in the Pacific.[57]

This remarkable record could not have been achieved except for the willingness of Arnold and Lovett to gamble. In the first move of "the three-billion-dollar gamble," the AAF entered into a contract for the plane's production long before it had been flight-tested; in September 1942 contracts had been let for 1,644 planes.[58] The full extent of the risk may be somewhat more exactly suggested by noting that the materials, measured by weight, required for one B-29 airframe equaled the requirement for eleven P-51's.[59] It was a gamble not so much with money, of which a wartime plenty existed, as with the allocation of scarce materials and manufacturing facilities. Boeing's existing plants were heavily committed to production of the indispensable B-17, so that for the B-29 program new factories at Renton in Washington and at Wichita in Kansas had to be built. It having been recognized that Boeing, even with greatly expanded facilities, could not carry the full load, the Bell Aircraft and Glenn L. Martin companies took part of the load at newly constructed and government-financed plants located, respectively, at Marietta, Georgia, and at Omaha, Nebraska.†[60]

The old problem of providing a motive force adequate to the size of the plane—which doubled the weight of the B-17—was ultimately solved by the Wright R-3350 engine. Even with a maximum horsepower almost double that generated by the engines of the B-17, the R-3350 could not meet the demand until further streamlining of the plane had been accomplished. The first quantity production order for the plane had been closed in 1941, but efforts to correct defects and

* See below, pp. 210–11.

† At the end of August 1945 the production record stood as follows: Wichita, 1,595; Renton, 998; Marietta, 652; Omaha, 515. The original three B-29's had been built at Boeing's Seattle plant.

to improve performance of the engine continued to be a major factor affecting plans for combat use of the plane for three years thereafter. In the B-29 the AAF secured at last its pressurized-cabin bomber. Among other new features, the chief was a central fire-control system. The usual armament was twelve .50-caliber machine guns, or ten machine guns and a 20-mm. cannon, all mounted in power-driven turrets.[61] Three models were used in combat: the B-29, B-29A, and B-29B. The bomb load—up to 20,000 pounds—was all carried internally. The crew included eleven men. A maximum fuel capacity of 9,548 gallons gave the B-29B a maximum range well over the 5,000-mile goal of Project A.[62] The justifiable satisfaction with which the AAF at war's end viewed the combat record of this plane came in no small part from the confirmation that record gave to a long-cherished faith in the practicability of the big bomber.

The *B-32*, only other very heavy bomber produced during the war, had been viewed essentially as insurance against failure of the B-29.[63] The first two XB-32's were shaped in no small part by Consolidated's experience with the B-24; like it, both were twin-tailed. Flight tests, beginning in September 1942, having revealed aerodynamic difficulties calling for redesign, the third experimental model was a single-tail plane. It performed more satisfactorily, and the AAF during 1943 and 1944 placed production orders for just under 2,000 of the aircraft.[64] In other words, the decision was to gamble on the hope of the plane's continued development, a natural decision in view of continuing uncertainties regarding the B-29 and of the advantage, in any case, of having two planes instead of one.[65]

Unhappily, the development of the B-32 lagged far behind that of the B-29. Not until August 1944 did the AAF put its first B-32 to service tests.* Not counting the three experimental models, only 13 B-32's had been accepted by the end of 1944; total production by the end of August 1945 had reached 118.[66] Only fifteen of these planes saw combat, in the western Pacific with the Far East Air Forces just at the close of the war.

The ultimate failure of the B-32 had been predicted by the NACA in 1942, to the great resentment of officials of the Consolidated Aircraft Corporation.[67] Nevertheless, the hope persisted at AAF Headquarters into the fall of 1944 that the plane had "nothing basically wrong which cannot be fixed."[68] By late 1944, however, the opera-

* See Vol. V, 332.

tional experience of the Twentieth Air Force had removed all doubts as to the worthiness of its Superfortresses, and Arnold's A-3 advised in December that a need no longer existed for the B-32 "as insurance against failure of the B-29."[69] In February 1945 the Acting Chief of Air Staff, Brig. Gen. Patrick W. Timberlake, added the opinion that the "B-32 in its present form is not an acceptable bomber." He cited two outstanding unsatisfactory features: the inability of the bombardier to see properly during the bomb run and the weight of the plane.[70] By summer it had been decided to limit production to a total of 214, of which 40 were to be used for training and the remainder for a variety of projects, including the equipment of one combat group in the Pacific. In October 1945 the AAF terminated its B-32 contracts and directed that all B-32 planes be declared excess and disposed of.[71] The moral perhaps is simply this: in heavy bomber development, where engineers necessarily work on the frontiers of experience and knowledge, success is achieved only at the cost of some failures. And those who in the hour of national emergency provided the B-17, the B-24, and the B-29 need offer no apologies for the B-15, the B-19, or the B-32.

*Fighters**

The chief fighter planes used by the AAF during World War II were the P-38, P-39, P-40, P-47, and P-51. In the earlier part of the war two groups in ETO were equipped with the British Spitfire,† and in the last year of hostilities the P-61, a night fighter, became a familiar item of AAF equipment. One other plane, the P-63, was manufactured in quantity,‡ but it was never used as a first-line combat plane and most of the output was sent to the U.S.S.R. on lend-lease.

During the 1930's the Air Corps fell behind other nations in the development of fighter-type aircraft. This lag is explained in no small part by a primary interest in the long-range bomber. Not only did that interest hold first claim on limited funds, but progress in the development of larger bombardment planes affected assumptions governing plans for fighter aircraft. The bombers built in the 1930's

* After May 1942 this was the official designation for planes variously designated theretofore as pursuit, interceptor, or fighter.

† See Vol. I, 642; II, 230.

‡ The AAF accepted 3,273 P-63's before the end of the war, but its peak inventory, in August 1944, for this plane was only 339.

flew at speeds equal to or even in excess of those achieved by contemporary pursuit models, and this fact, as GHQ Air Force explained early in 1940, "advanced the thought that airplane design had reached the point where a large airplane could be made to go as fast as a small one and that the defensive armament of the large plane was more than a match for the small plane."[72] From this line of reasoning may be traced one of the major blunders of the AAF—its failure to provide in advance for the need of escort fighters in its heavy bomber operations. The big bomber, it was assumed, could take care of itself, and thus no need even existed for developing a fighter of sufficient range to serve as an escort plane. Conversely, the proponents of the self-defending big bombers argued that the role of the fighter as an interceptor would decline, an argument which may help to explain another glaring deficiency of the war years—the lack of an effective night fighter, whose job is basically that of interception, until late in the war. How far the point should be pressed is debatable, but there can be no doubt that Air Corps doctrine in prewar years assumed "the ascendancy of bombardment over pursuit" and that this assumption hindered the development of pursuit aircraft.[73]

At the opening of hostilities, pursuit units of the Air Corps depended chiefly upon two planes, the *P-39* (Airacobra) and the *P-40* (Warhawk).* Both of them were approaching obsolescence despite the fact that they had been in production for not more than eighteen months on 7 December 1941.[74] Especially disappointing was the P-39, whose low ceiling, slow rate of climb, and relative lack of maneuverability put its pilots at a decided disadvantage wherever they fought.† The P-40 proved to be a much better plane. Though a slow climber, given time it could reach altitudes permitting superior skill and tactics to offset the advantages of the enemy. The record set with the P-40 by more than one commander, but especially Chennault in China, was very creditable, but as other planes became available a continuing equipment of P-40's was an unfailing mark of low priority. That the plane's record owed much to the fact of its employment chiefly against the Japanese rather than the German Air Force is indisputable.

In 1936 and 1937, the years in which the P-39 and the P-40 had

* The two planes constituted more than half of all AAF fighters until July 1943, and prior to September of that year more than half of all those committed overseas. By August 1944 all P-39 groups had been converted and in July 1945 only one P-40 group remained in operation.

† See Vols. I, II, and IV, *passim*, but especially IV, 24, 41–42, 262–63.

been designed, the job indicated for them by national policy was one of coastal defense and of support for ground combat.[75] And for those jobs the planes were not badly designed. No potential enemy promised to put high-level bombers over our coasts, and against an amphibious assault the rugged qualities of the two planes at low levels should have made them most useful in beating off the assaulting forces. In low-level strafing and bombing, the P-39 and P-40 repeatedly showed their worth during the war; as Kenney reported from the Southwest Pacific, each of the planes could "slug it out, absorb gunfire and fly home."[76]

The Bell P-39 and the Curtiss P-40 were both single-engine monoplanes. The P-40 was slightly larger in dimensions, but the airframe weights of the later models of the two planes were about the same—approximately 4,000 pounds—and the combat weights were identical. The P-39 was unique in having its Allison V-1710 engine mounted behind the pilot's cockpit instead of in the nose of the plane, a feature some pilots regarded as making the plane more vulnerable. A 37-mm. gun mounted in the nose fired through the hollow driveshaft. By contrast with the radical design of the P-39, the P-40 was essentially a further development of the P-36. The P-40 gained greatly improved performance by installation of a liquid-cooled Allison V-1710 engine in place of the P-36's air-cooled R-1830 engine.[77] Like other combat planes used during World War II, the P-39 and the P-40 increased in weight. The later models of the P-39, beginning with the D, had an airframe weight almost 50 per cent greater than that of the XP-39 and the increase in combat weight was almost as great. The increase in airframe weight of the P-40 ranged up to 10 per cent, but the increase in combat weight was almost 20 per cent. These changes resulted chiefly from the installation of armament, armor, and additional equipment. The P-39, starting with two .30-caliber and two .50-caliber machine guns and one 37-mm. gun, had two .50-caliber guns added to later models. The original P-40 carried only two machine guns, but most combat models carried six .50-caliber machine guns.[78]

The P-39D, first Airacobra produced in quantity, had a maximum speed of 368 miles per hour at an altitude of 13,800 feet. Later models showed no real improvement, though the increased horsepower of their engines did compensate for the increased weight. The story is much the same with the P-40, which held to a standard of 350 miles per hour at an altitude of 15,000 feet. Climbing speed tended to fall

as weight was added, and the ceiling remained low. Both the P-39 and the P-40 were credited with service ceilings, ranging throughout the various models, from 31,000 up to 38,000 feet; in practice, they rarely, if ever, reached these ceilings, certainly not in combat. The Allison V-1710 engine used in the planes had a critical altitude* of about 12,000 feet and lost power at higher altitudes. Combat at altitudes above 15,000 feet was rarely attempted.[79] The over-all limitations of the two planes were such that the addition of superchargers seemed inadvisable in view of the promise that superior planes could be substituted.†

The first of these superior planes to make its appearance was the Lockheed *P-38* (Lightning)—a high-flying twin-engine fighter of outstanding qualities. Designed in 1937 for high-altitude interception, the plane was Lockheed's first venture into military production. Air Corps tests of the experimental model began in January 1939, just as the Presidential program was giving a new impetus to all plans for aircraft production. In April an order for thirteen service-test models was placed; in September a production order for sixty-six planes was negotiated. A second order, this time for 607 planes, followed in August 1940, despite the fact that the first service-test model was yet to be delivered. Production continued to lag: delivery of the 13 planes first ordered was not completed until June 1941; total deliveries reached only 39 by the middle of August; and, while acceptances in November went up sharply to 74 planes, the AAF inventory on the eve of Pearl Harbor showed no more than 69 P-38's.‡ For these delays, the AAF was inclined to blame Lockheed, and suspicion existed that the company preferred to concentrate on its own commercial Lodestar and on British orders for the Hudson.[80] Whatever the fact, the delay was costly.

This plane, whose second engine proved a comforting feature to its pilots, achieved a top speed ranging upward from 390 to 414 miles

* Critical altitude is altitude at which the greatest speed is attained by the airplane in level flight using military rated power and with all design gross weight items installed.

† Between 1940 and 1944, when acceptances ended, a total of 9,558 P-39's and 13,738 P-40's were accepted. Peak AAF inventories show 2,150 P-39's in February 1944 and 2,499 P-40's in April of that same year. As these figures suggest, the greater number accepted were eventually shipped to our Allies, among whom the Russians valued especially the P-39 for its effectiveness in low-level support of ground troops.

‡ It should be noted, however, that there was usually a time lag between acceptance of a plane and its appearance in inventories.

per hour. Its rate of climb gave the pilot an even chance and its range was such as to encourage the AAF to experiment in 1942 with flying P-38 units to their station in England.* As a fighter-bomber with a bomb load of 2,000 pounds, the plane had an average combat range of 600 to 700 miles. On escort duty, with no bombs and a maximum fuel load, later models approached a range of 2,000 miles, though for practical purposes 1,500 miles was about the limit. In ferrying, the reach might be 2,500 miles.[81] The two V-1710 engines of models J and L each generated 1,450 take-off horsepower, thus providing a power unit equal to the plane's size, which at the start was double that of the P-39 or the P-40. The usual armament of four .50-caliber machine guns and one 20-mm. gun was supplemented as needed by an external bomb capacity reaching 3,200 pounds. Fuel capacity was expanded from the 310 gallons of the earlier models to a remarkable 1,010 in the later series. The P-38 was the first fighter to be equipped with turbosuperchargers, permitting operation at greater speed at high altitude.[82]

It was also the first AAF fighter that could in any way be compared with the Messerschmitt 109 or the British Spitfire.† Seeing service in all theaters, the plane effectively performed the varied functions of a fighter and in a modified version proved especially useful for photo reconnaissance. By the spring of 1944 there were thirteen P-38 groups overseas. Total acceptances from the factory reached 9,536 at the end of August 1945. Peak production had been reached in August 1944. The highest point of inventory came in March 1945.[83]

The AAF had come by the end of the war to depend still more heavily upon Republic's *P-47* (Thunderbolt). In fact, after January 1944 groups equipped with P-47's represented better than 40 per cent of all AAF fighter groups serving overseas; after March of that year inventories never showed less than 5,000 of the planes on hand. The top listing in May 1945 was 5,595. At summer's end in 1944 the AAF had 31 P-47 groups, a total which reflected the rapid rise in production from 532 planes in 1942 to 4,428 in 1943 and over 7,000 in 1944.‡[84]

* See Vol. I, 641–45.

† The Me-109G had a maximum speed of 400 miles per hour at altitude and a range of over 600 miles. The Spitfire IX had a maximum speed of 406 miles at altitude and a range of 425 miles.

‡ 3,559 were added before August 1945. Republic produced all P-47's except for 354 by Curtiss-Wright.

The Thunderbolt had been designed in 1940, at a time when the Air Corps had become fully alerted to the need for a plane that would compare with the best European models. The original experimental model was powered by a liquid-cooled engine, but there were doubts in 1940 that engine production could keep up with the demands of a program depending upon liquid-cooled engines for all Air Corps fighters. Accordingly, it was decided to switch to a new Pratt & Whitney R-2800 air-cooled engine, even though this called for redesign of the plane and a consequent delay in its production.[85] The XP-47B with its air-cooled engine first flew in May 1941; the first production article was not accepted until the following December. Meanwhile, testimony of the high hopes entertained for the plane was given by employment of such leading Air Corps pilots as Col. Ira C. Eaker in its test-flights.[86] For a time it was hoped that the plane could benefit from combat-testing by making the P-47 available to the RAF in the Middle East. But technical difficulties affecting production plans led Arnold in September 1941 to notify the British that it would be inadvisable to try the plane in combat until "teething troubles" with "a combination of a new airplane, a new engine and a new supercharger" had been overcome. At that time an overoptimistic estimate set May 1942 as the earliest date on which the plane might be ready;[87] actually, the AAF found it impossible to get the P-47 into combat before April 1943.* Production had begun to move in the preceding spring. The first P-47 group was equipped in November 1942 and in January reached England, where two more months were required to straighten out difficulties with the engine and with communications equipment. Thereafter, the P-47 came fast.

It was a powerful plane. Its engine with more than 2,000 horsepower put the P-47 ahead in this category of all single-engine fighters of the AAF and gave it rank with any other contemporary single-engine fighter in the world. With its superchargers, the plane climbed fast and performed admirably at high altitude. Its stubby appearance bespoke a ruggedness exceeding that of any other AAF fighter, and no plane of the war proved itself more versatile. With a powerful armament of six to eight .50-caliber machine guns and the additional capacity for six 5-inch rockets with a 2,000-pound bomb load, or for ten rockets without bombs, the P-47 proved that the fighter-bomber provided the best answer to the long quest for an outstanding attack

* See Vol. II, 335.

plane.[88] Though employed with satisfaction in all major theaters, the Thunderbolt probably deserves to be remembered chiefly for its work in the Ninth Air Force as a fighter-bomber following the invasion of western Europe in 1944.* It had no peer as an escort plane except for the P-51. The original fuel capacity of a little over 300 gallons severely restricted its radius of action, but the addition of belly and wing tanks brought the full load in the P-47N up to 1,266 gallons for ferrying purposes. Combat fuel loading usually ranged from 300 to 600 or 700 gallons, depending on the need. Beginning in 1943 with a combat range of about 500 miles as a fighter-bomber and 1,000 miles as an escort fighter, the P-47 in its later models extended the figures to 800 and 2,000 miles. Top speed, meanwhile, had increased from some 425 miles per hour to 460. The rate of climb below 25,000 feet fell off as a result of increased combat weight, model N weighing 3,000 pounds more than D, the first series in large production.[89]

The story of the *P-51* came close to representing the costliest mistake made by the AAF in World War II. By 1943 it was becoming all too clear that the big bombers would require the protection of full fighter escort if an effective campaign of strategic bombardment against Germany was to be maintained.† Prewar assumptions as to the "ascendancy of bombardment over pursuit" long since had been dropped, but understandably there continued to prevail an opinion which had been formally expressed in 1940 in these terms: "no fighter plane can be designed to escort heavy and medium bombardment to their extreme tactical radius of action and there engage in offensive combat with enemy interceptor fighter types on equal terms." The escort plane, it was concluded, "in order to have the range and speed of the aircraft it accompanies, may be as large and at least as expensive as such aircraft."[90] In 1941, when plans for the giant B-36 were under discussion, it was suggested that an escort of comparable size might have to be provided,[91] and AWPD/1, the AAF's basic war plan of that same year, recommended for solution of the more immediate problem a plane that was essentially a modified bomber. As the Eighth Air Force began its bombing operations in August 1942, a special board headed by Brig. Gen. Alfred J. Lyon recommended modifica-

* See especially Vol. III, Chaps. 7 and 8.

† For this story, with notice of the early correction of prewar assumptions regarding the capacity of the big bomber to take care of itself, see Vol. II, *passim*, but especially pp. 229–31, 267–68, 334–37.

tion of the B-17 and B-24 to provide needed "destroyer escort planes."* This led to an unsuccessful experiment by the Eighth Air Force in 1943 with the YB-40, a modified B-17 sent over in the hope that it might meet the growing need for long-range escort.†

Meanwhile, the answer lay in two developments which in origin were unrelated to the search for an escort plane. The great distances over which planes had to be delivered to widely scattered combat zones, together with a critical shortage of shipping for the purpose, had forced the AAF in 1942 to give close attention to possibilities for extending the range of its planes to a point that would permit the ferrying of as many of them as possible to their combat stations. To this impulse there was quickly added the need for the longer range required to meet developing combat demands in the several theaters. As a result, by 1943, and in many different places within the AAF, experimentation was demonstrating possibilities for the extension of fighter ranges which surprised American, British, and enemy combat commanders alike.‡ The problem was largely one of increasing fuel capacities, and the most important of immediate aids to this end was found in the disposable fuel tank, a device known for many years and to which the AAF had given close attention since 1940.[92] As the engineers concentrated on all aspects of the problem, increased range came to be the single most distinguishing feature in the development of AAF planes during World War II. And of all fighter types none had the potentiality displayed by the P-51, a plane which the AAF had been slow to appreciate.

It had been designed by North American for the British in 1940, as a substitute for the P-40's asked for by the RAF. The P-51 had its genesis in improvements contemplated by the Air Corps for the P-40, and Curtiss turned over to North American useful technical data. But the Air Corps' plans had come to depend on the P-38 and the P-47; accordingly, the Air Corps took only a limited interest in the P-51, stipulating that it be provided with two free articles in the event production for the British was attempted. Production got under way in the latter half of 1941 in accordance with relatively modest orders

* See Vol. I, 604.

† See Vol. II, particularly pp. 268, 680.

‡ This extension, though the impulse came from an interest in ferrying, proved to be of importance primarily to tactical operations. With the help of deck-loading, it was possible to send most fighters by ship.

from the British, who first put the plane to work in their Army Co-operation Command for ground support. The RAF was quick to recognize the Mustang as "the best American fighter that has so far reached this country," and began to compare it favorably with the Spitfire, currently rated as the world's best fighter.[93] Our assistant military attaché in London, Maj. Thomas Hitchcock, reported to Washington in the fall of 1942 that the P-51 was "one of the best, if not the best, fighter airframe that has been developed in the war up to date." Dropping into the vernacular of his interest as a famous horseman, he advised "development of the Mustang as a high altitude fighter" by "cross-breeding it with the Merlin 61 engine."[94] Others, including Eddie Rickenbacker and AM Sir Trafford Leigh-Mallory, confirmed Hitchcock's report,[95] and within a month Arnold could notify President Roosevelt that the Rolls Royce engine was being tested in the P-51 and that approximately 2,200 of the planes already had been ordered by the AAF.[96]

This was in November 1942, and the extensive changes attendant upon the substitution of a new engine held up production through the following winter.[97] Not until November 1943 did the AAF get a P-51 group to the United Kingdom, and it flew its first long escort mission on 13 December—490 miles to Kiel and back—which was the record to date. In the following March the Mustangs accompanied the heavies all the way to Berlin. Considering the late start, the production record was a remarkable one. By August 1944 the production rate had passed that of the P-47, and by the close of the war, a year later, the AAF inventory of the plane had reached the huge total of 5,541.[98] The Eighth Air Force had converted all save one of its fighter groups to P-51's, the P-47's going to the Ninth Air Force; everywhere the strategic forces held first claim. Following the capture of Iwo Jima in February 1945, the Mustangs added to their already secure reputation as the world's best escort by aiding the B-29's in their mounting assault on Japanese targets.* After the war Arnold frankly admitted that it had been "the Air Force's own fault" that this superior plane had not been employed earlier.[99]

A single-engine, low-wing monoplane, the P-51 was much lighter than either the P-38 or the P-47. Though the combat range of the original P-51, built to meet the short-distance needs of the RAF, had not exceeded 400 miles, it reached 1,800 miles with the P-51H, which

* See Vol. V, 586–87, 597.

had a top speed of 487 miles per hour. Its service ceiling of better than 40,000 feet made it a truly high-altitude fighter. The plane normally carried six .50-caliber machine guns, and it could take rockets or bombs up to 2,000 pounds.[100]

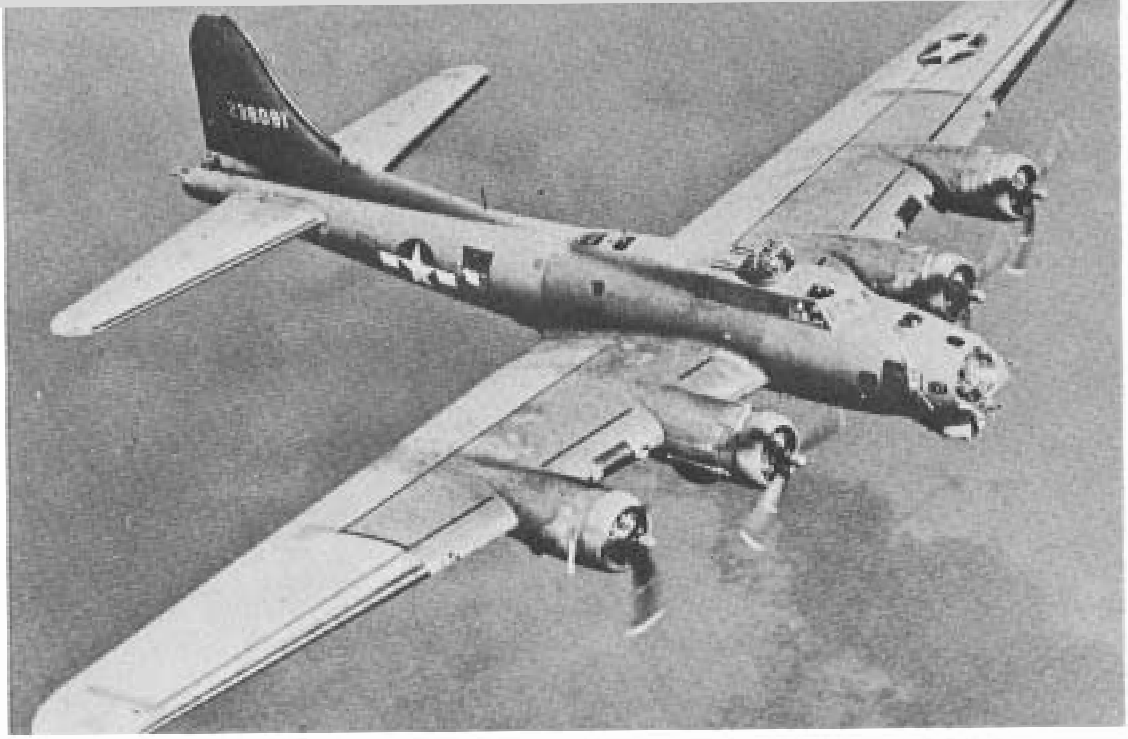
The Northrop *P-61* (the Black Widow), which saw service during the last year of the war, was the first American plane specifically designed for service as a night fighter, for which a need had been repeatedly felt from the early days of hostilities. Design had been begun by Northrop in November 1940 at the instigation of the Air Corps, and a formal contract for two experimental articles was signed in January 1941. Subsequently, orders were placed for more than 2,000 planes, but only 682 had been delivered by August 1945. The first XP-61, though test-flown on 26 May 1942, was not delivered to the AAF until July 1943; deliveries on production contracts began late in 1943. P-61 squadrons were in action with the Ninth Air Force in the European theater before D-day and appeared in the Mediterranean and Southwest Pacific theaters during the summer of 1944. The coal-black plane proved itself capable of a variety of night missions, operating as an intruder* as well as an interceptor.[101] An attempt to modify a late model P-61 for use as a long-range day fighter was made in 1945, but the development was overtaken by the end of the war and subsequently dropped.[102]

The Black Widow was an all-metal monoplane with a twin fuselage and a twin tail, somewhat resembling the P-38 but much larger. It had two Pratt & Whitney R-2800 engines, each of which developed more than 2,000 horsepower. In size, the P-61 was more nearly comparable to the medium bombers than the fighters. Its wing span and length were greater than those of the A-20, and its combat weight of 28,000 pounds was at least 2,000 pounds more than that of the A-20. It was almost three times as heavy as the P-51 and almost twice as heavy as the P-47 at combat weight. Its internal fuel capacity of 640 gallons was supplemented by two or four wing tanks, each of which held 165 or 310 gallons of fuel. This gave some of the P-61's a fuel capacity of 1,880 gallons—a capacity which was rarely, if ever, used. The original combat range of 700 to 800 miles went up to better than 1,000, and the ferrying range ultimately doubled that figure. Its armament consisted of four .50-caliber machine guns and four 20-mm.

* Intruder missions were usually night nuisance raids by single planes against enemy targets.

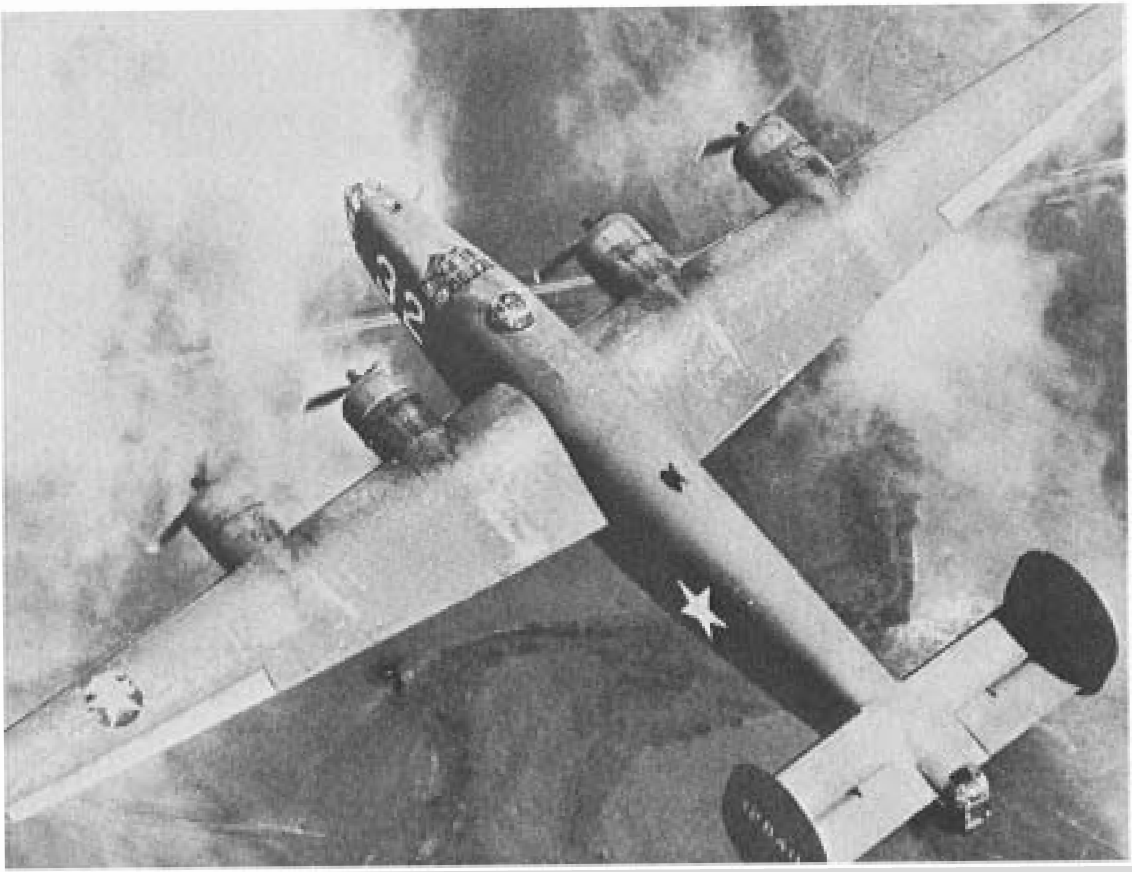
B-25 NORTH AMERICAN MITCHELL

B-26 MARTIN MARAUDER



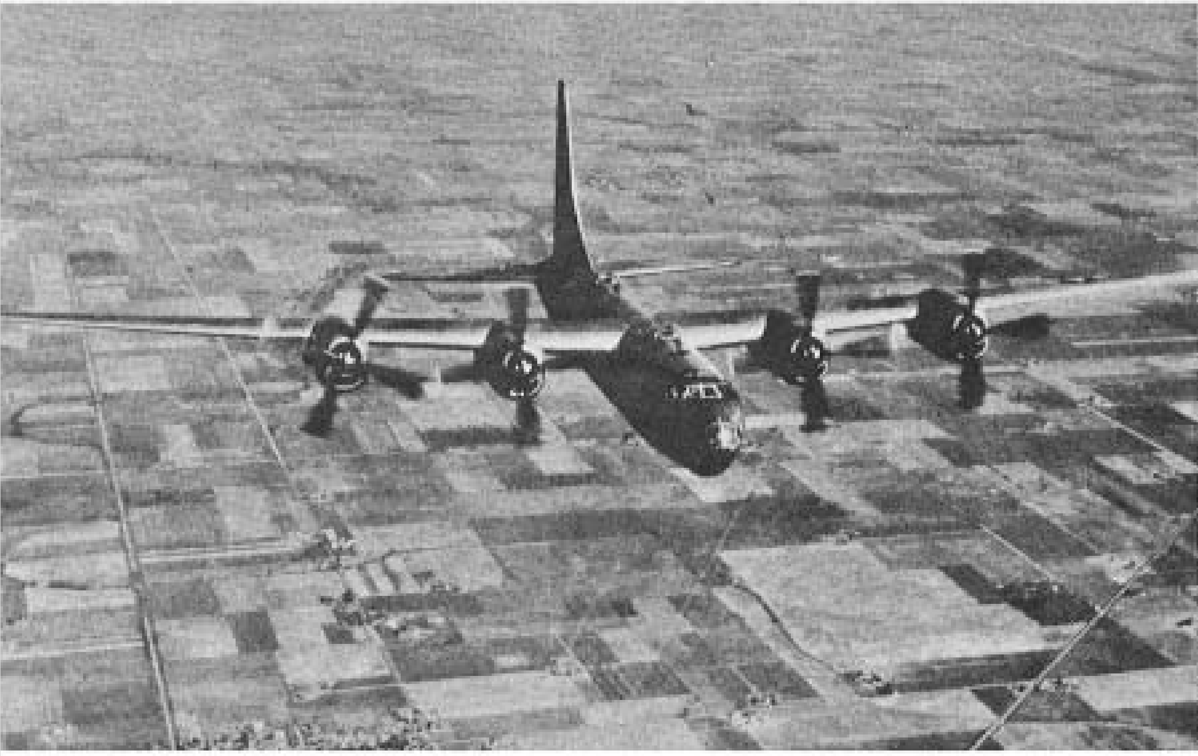
B-17 BOEING FLYING FORTRESS

B-24 CONSOLIDATED LIBERATOR



B-29 BOEING SUPERFORTRESS

B-32 CONSOLIDATED DOMINATOR

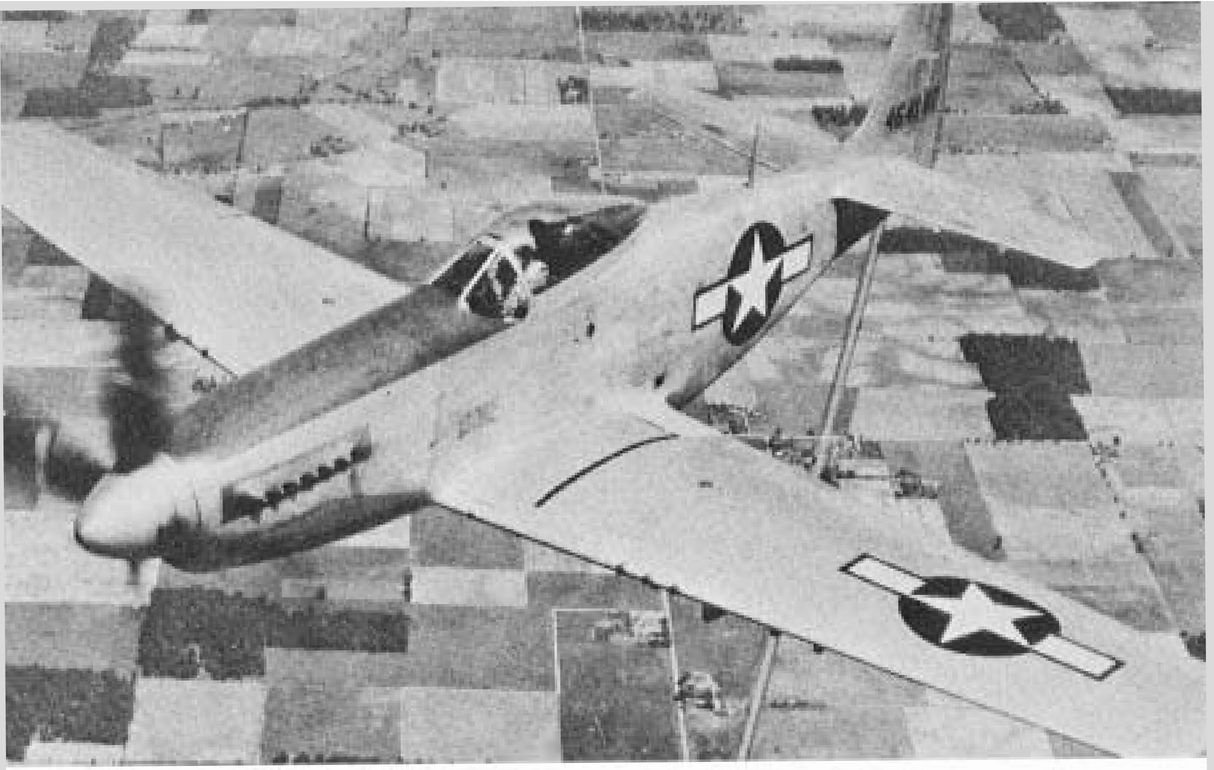


P-38 LOCKHEED LIGHTNING

P-39 BELL AIRACOBRA

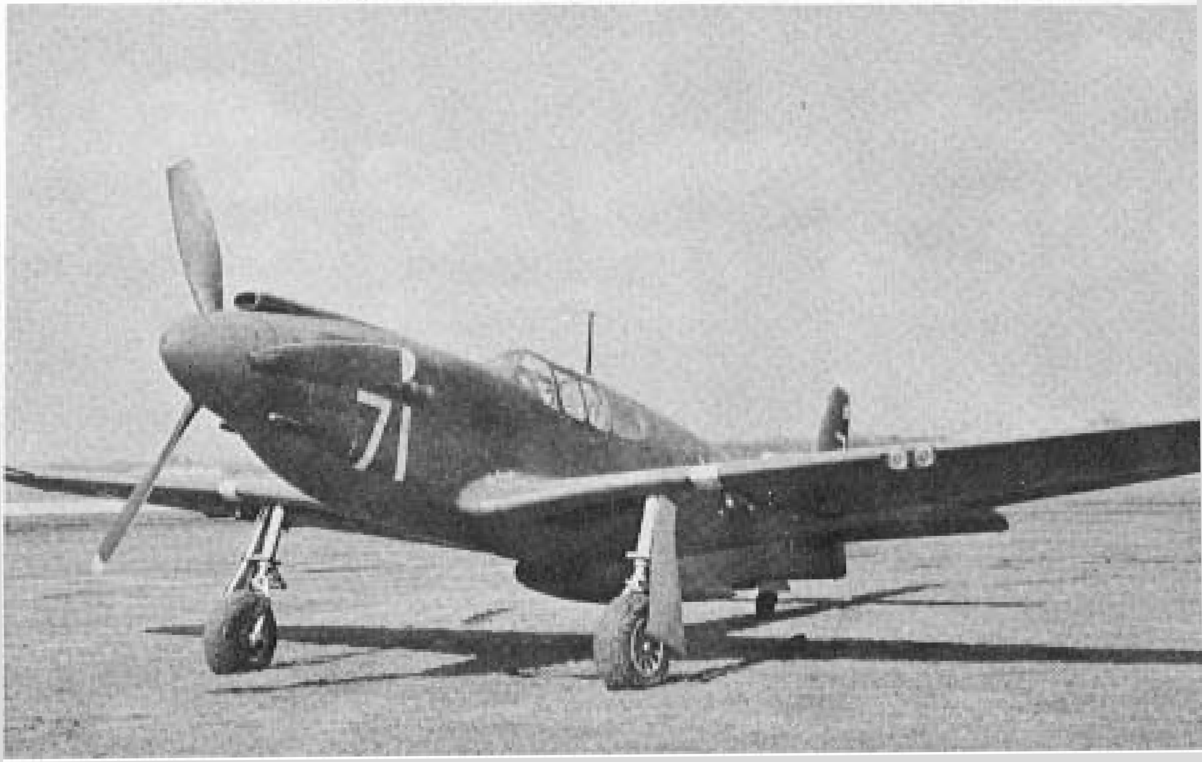
P-40 CURTISS WARHAWK

P-47 REPUBLIC THUNDERBOLT



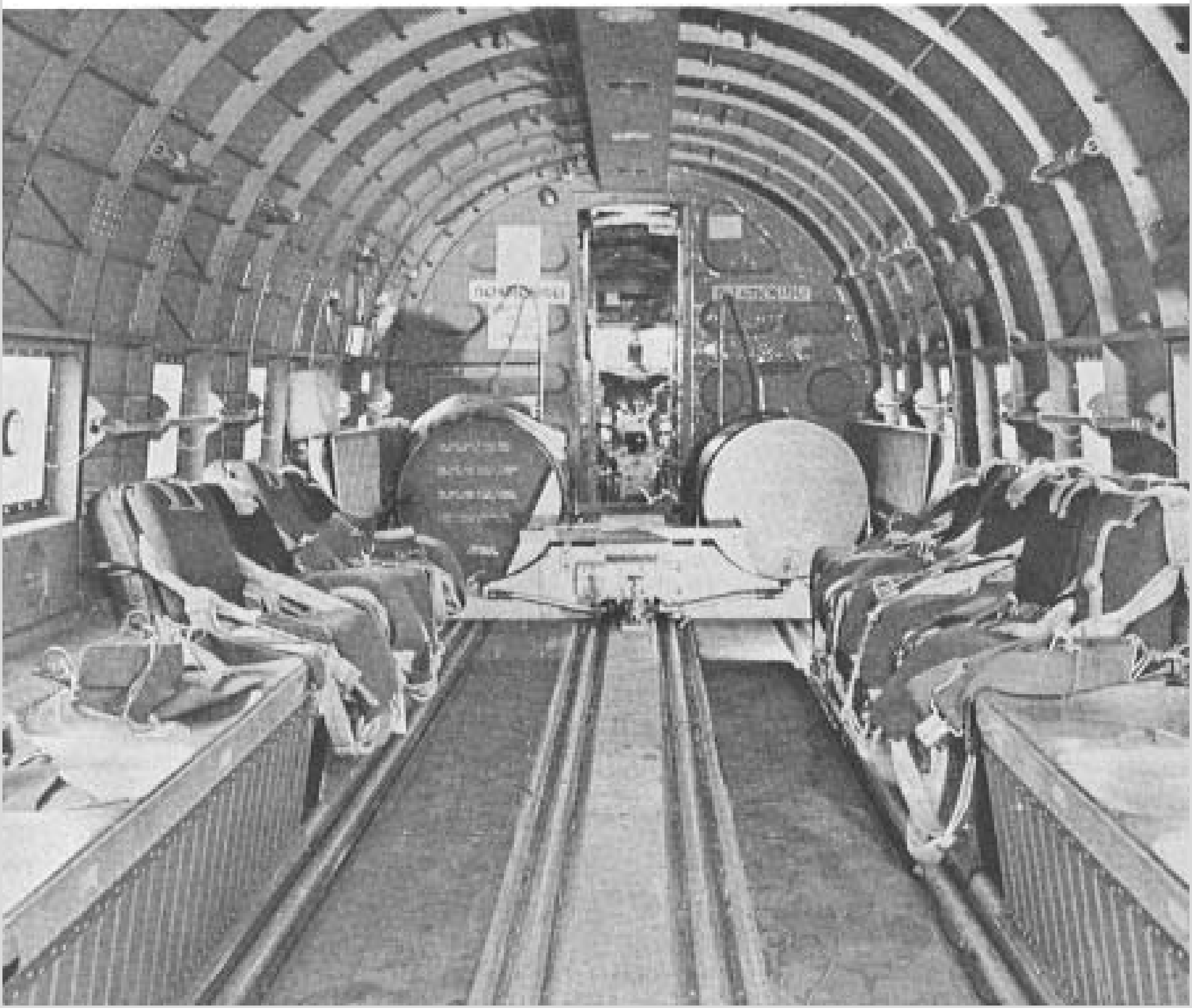
P-51 NORTH AMERICAN MUSTANG

A-36 NORTH AMERICAN (FIGHTER-BOMBER VERSION OF MUSTANG)



C-47 DOUGLAS SKYTRAIN

C-47 INTERIOR VIEW

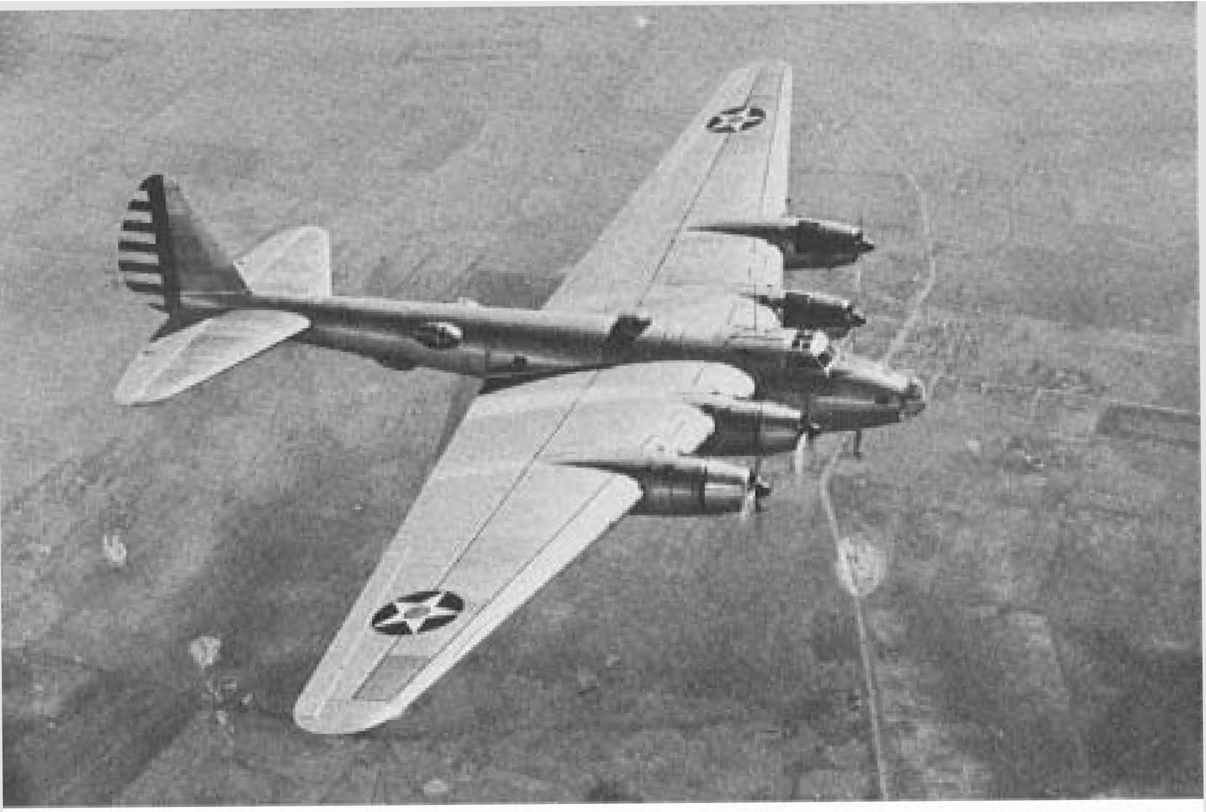


C-46 CURTISS COMMANDO

C-54 DOUGLAS SKYMASTER

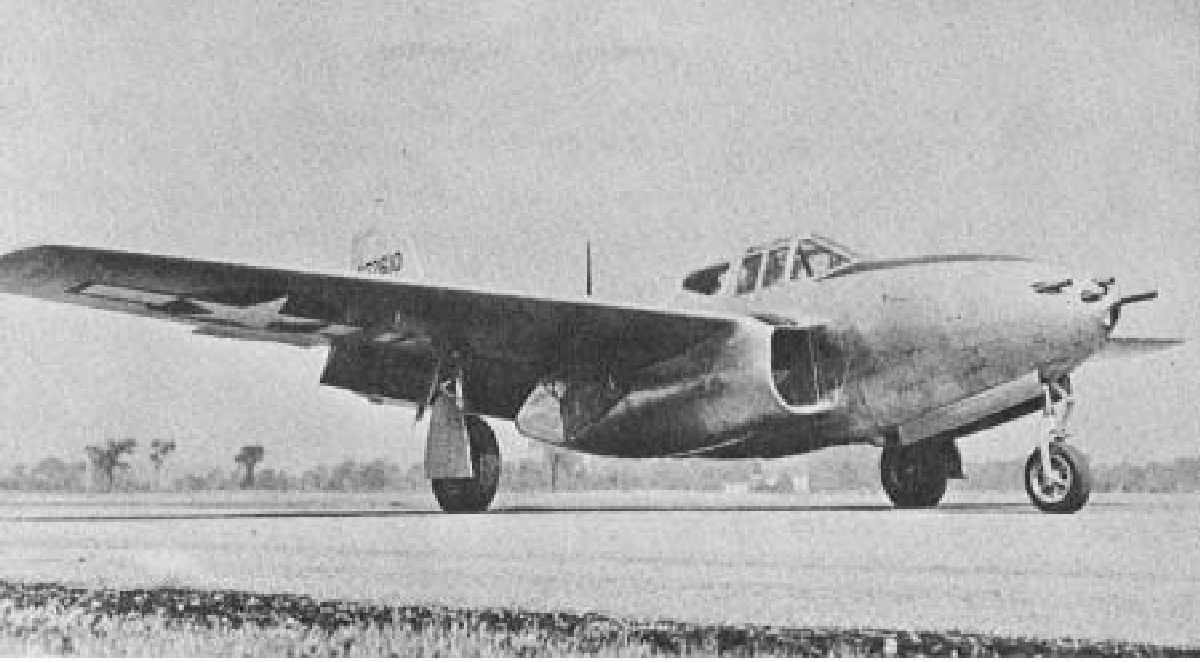
L-4 PIPER GRASSHOPPER

L-5 VULTEE SENTINEL



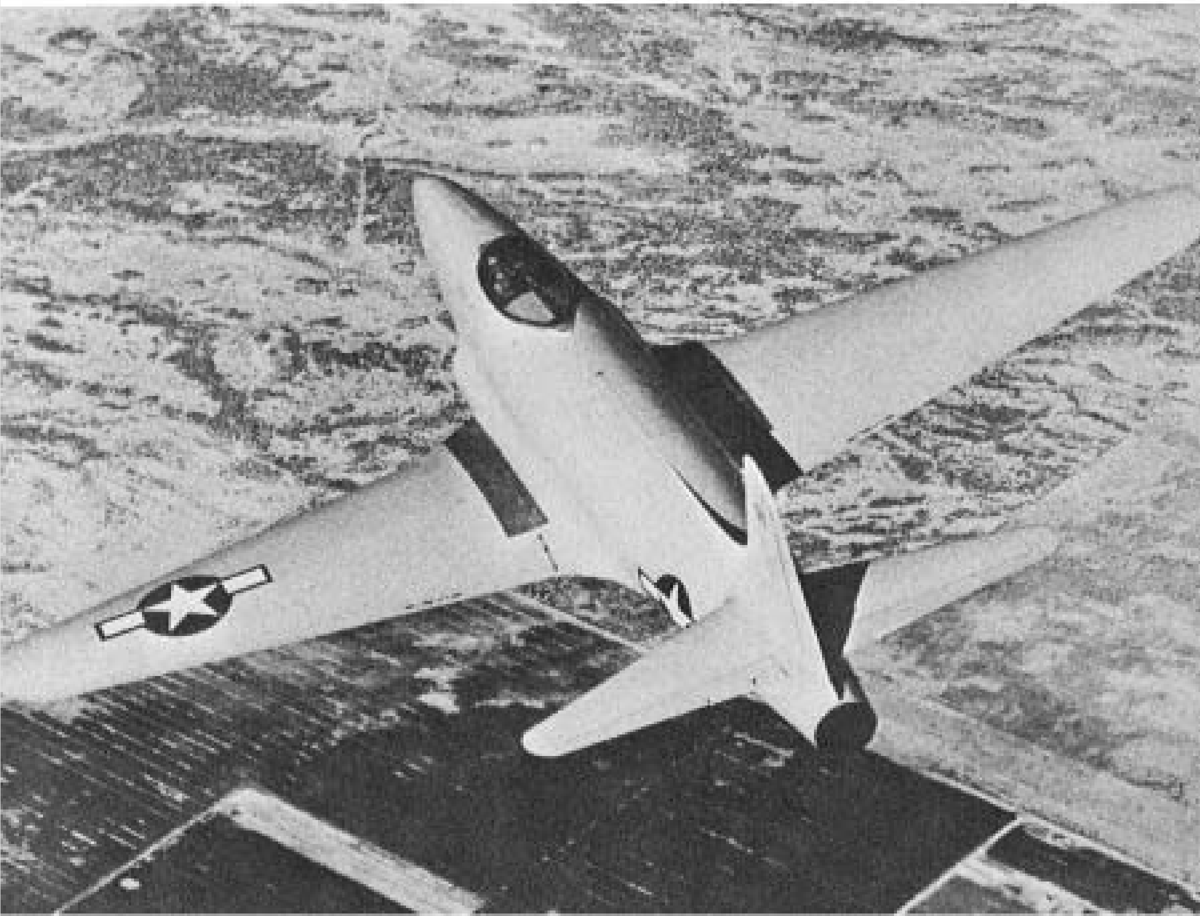
XB-15 BOEING

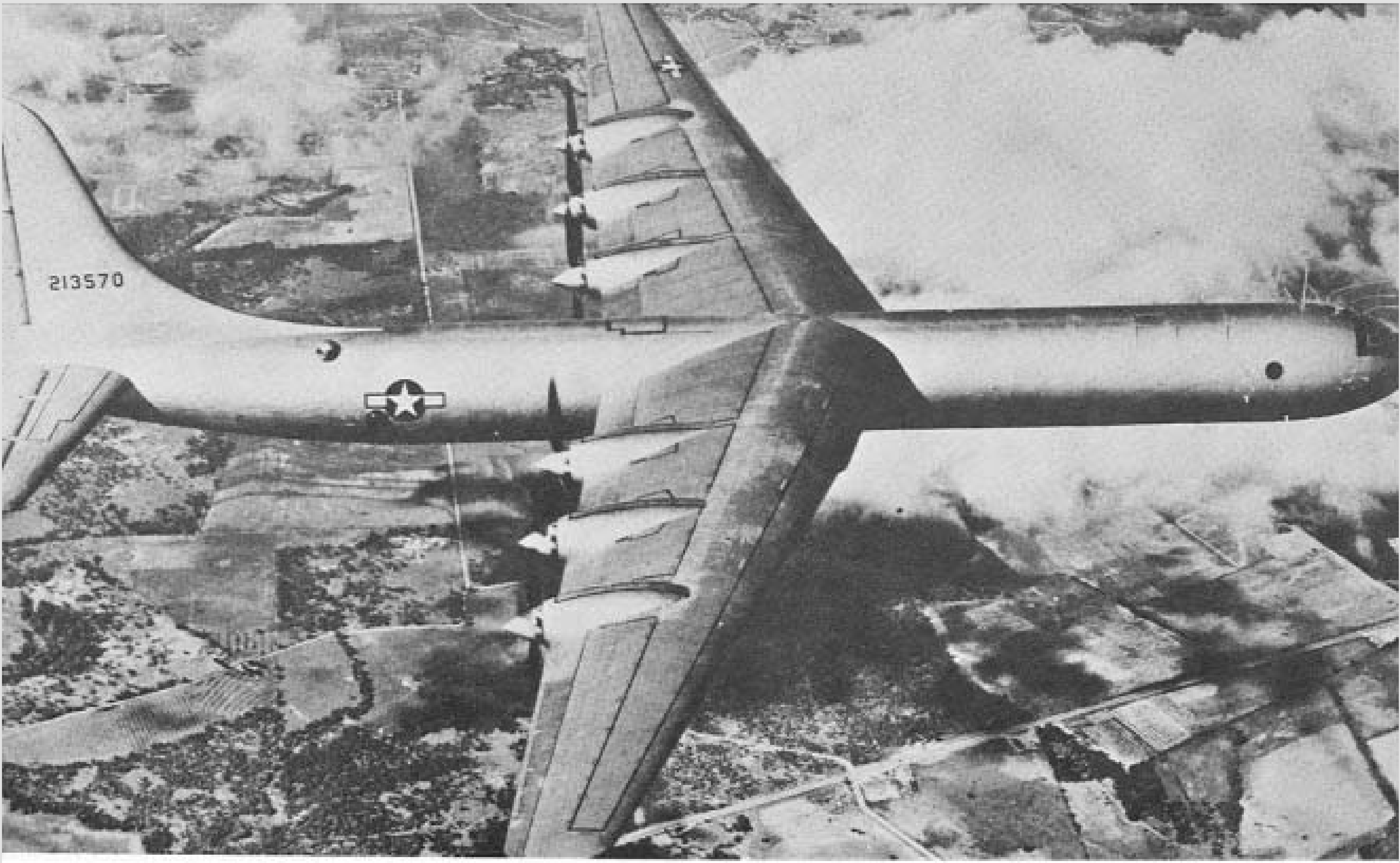
P-82 NORTH AMERICAN TWIN MUSTANG



P-59 BELL

P-80 LOCKHEED SHOOTING STAR





B-36 CONSOLIDATED VULTEE

guns, and some models were equipped to carry either 3,200 or 6,400 pounds of bombs externally. The most notable feature of the plane was the large quantity of radar and communications equipment it carried in order to permit effective night operation. The P-61 carried a three-man crew consisting of a pilot, radio operator, and gunner. Top speed remained at about 360 miles per hour and the maximum ceiling was over 30,000 feet. The plane proved to be highly maneuverable, more so than any other AAF fighter.[103]

Though dependent upon a bit of luck with the P-51, the AAF had three outstanding fighters, and of these two were for their respective tasks superb.

Reconnaissance and Liaison

In the early days of military aviation, reconnaissance, then known as observation, had been the prime mission of the Army's air arm. The importance of reconnaissance, except in relation to other and rapidly developing potentials of the airplane, had suffered no decline in the years between the two world wars. Indeed, experience in the second war soon indicated that this old mission had acquired a growing significance as an intelligence service indispensable not only to other arms but also to the success of the AAF's own special operations. The planning, execution, and assessment of air operations—and this was particularly true of strategic bombardment—depended most heavily on photo reconnaissance. The Air Corps, however, had developed no plane specifically designed for the performance of this function, and the AAF remained dependent throughout the war upon its standard combat models or modifications of them for the special purposes of reconnaissance. The one exception was found in the small, short-range planes employed for artillery spotting.[104]

In October 1943 the Hughes Aircraft Company undertook to produce a plane having the range, speed, and other requirements for a special reconnaissance-type plane. Designated the *F-11*, the aircraft was supposed to show a minimum range of 3,000 miles, a ceiling of 60,000 feet, and a speed of 400 miles per hour. These specifications were so high as to be considered by the Materiel Command as virtually impossible of attainment.[105] But Arnold, yielding apparently to the insistence of Col. Elliott Roosevelt, one of the AAF's most experienced photographic reconnaissance officers, decided to gamble on the F-11 despite the persistent objections from the Materiel Command

and the Air Staff. He later explained that nothing else was in sight and admitted that his "guess was wrong."[106] The first F-11 was not turned over to the AAF until well after the end of the war, and it did not measure up to specifications. Early in 1944 the AAF had got Republic going on a four-engine reconnaissance type, but it proved impossible to produce the plane before the end of the war, and the project was eventually dropped.[107]

Meanwhile, the more adaptable of the combat planes had been converted for reconnaissance purposes.* Of these the P-38 served chiefly, AAF inventories at the beginning of summer in 1945 showing something over 800 of the F-4 and F-5 out of the approximately 2,000 photo-types on hand. The P-51, as the F-6, did good work in Europe. Only the B-29, as the F-13, had the necessary reach for aid to strategic operations in the Pacific. Satisfactory over-all figures are difficult to get, for the modification, which represented chiefly adjustments for different equipment, was often made in the theater on standard models. Efforts to procure the celebrated British Mosquito bomber for adaptation proved disappointing.[108]

Provision for the Army's need of observation planes presented a different problem. During World War I, though distinctions of function affected the design of military aircraft, most standard models had capacities sufficiently limited to allow diverse employment of them. But by the second war the standard planes of the AAF were of a size that did not permit landing on any strip, and they operated at speeds which gave them little utility for the type of service required for such tasks as artillery spotting. The need was for a small and highly maneuverable plane that could operate under almost any weather and airfield conditions.

Despite prodding by the General Staff, the Air Corps had failed to produce a satisfactory liaison plane (the designation adopted in 1941), a failure attributable in part to the continuing conviction that a small, slow, unarmed plane could not survive in the battle area. Success with small commercial-type aircraft in the maneuvers of 1941 confirmed the Army in another and, as events proved, correct opinion. By Janu-

* The photographic planes and their combat equivalents were:

F-3	A-20	F-8	Mosquito
F-4	P-38	F-9	B-17
F-5	P-38	F-10	B-25
F-6	P-51	F-13	B-29
F-7	B-24		

ary 1942 the AAF had been given responsibility for providing almost 4,000 "puddle jumpers" for the Army. The job was not well handled; only the fact that large-scale ground operations were delayed until 1944 and 1945 kept the supply within reach of the great demand created by the needs of the Army, as well as the Civil Air Patrol, the Civilian Pilot Training Program, and the Office of Strategic Services. The AAF itself also planned to use this type of plane in large numbers for miscellaneous purposes, such as liaison between bases. The several interested parties at times worked at cross-purposes, and requirements were subject to many changes. To put it briefly, there was much confusion.[109] Eventually, two first-class models emerged: the *L-4* (Piper Cub) and the *L-5* (Stinson), both adaptations of commercial types. Assigned to divisions, corps, and armies, they performed a wide variety of functions, which included observation, artillery adjustment, aerial evacuation, column control on the march, wire laying for communications, camouflage checking, liaison, and courier work. The AAF accepted a total of 5,611 L-4's and L-14's (improved version of the L-4), and 3,590 L-5's, which together constituted more than 65 per cent of the 13,558 liaison-type planes accepted between June 1940 and August 1945. The peak inventory was 4,211 of these planes in June 1944.[110]

Transport and Troop Carrier

The AAF was hardly more successful in producing specialized aircraft for its rapidly growing air transport service than it had been in developing a photo reconnaissance or a liaison plane. As in the case of the liaison plane, it had to adapt already proved commercial transports to military use, and as with the photographic plane, it became necessary to modify combat aircraft, bombers specifically, for transport purposes. There was little debate as to what was desired: some plane equally useful for the delivery of either cargo or troops to their destination; but the only plane specifically developed for this purpose during World War II, the C-82, did not actually see service until after the war.[111] Meantime, great resourcefulness was displayed in meeting emergency demands on wholly unanticipated scales with the equipment that could be made available. The planes which formed the backbone of the AAF's transport fleets were the C-47, C-46, and C-54.

The Douglas *C-47* (Skytrain) was a military cargo version of the

DC-3, stand-by of the commercial airlines for a number of years before Pearl Harbor. With other modifications the DC-3 became the *C-53*, a troop and hospital transport. A steady and proved aircraft, the C-47 earned for itself a reputation hardly eclipsed even by the more glamorous of the combat planes. The work horse of the air, one found it everywhere, and everywhere, whether shuttling freight or airborne troops, it did the job dependably. Before the war was over the AAF had accepted more than 10,000 DC-3 type planes, which was nearly half the transport planes it received between 1940 and 1945.[112] In troop carrier units the C-47 usually carried a four- or five-man crew.

The Curtiss-Wright *C-46* (Commando) was the military version of an as yet unproved commercial transport. Like the C-47, it was a twin-engine monoplane but much larger and heavier, with a maximum cargo capacity of 15,000 pounds against 10,000 for the C-47, and a passenger load capacity of 12,000 pounds against 6,500 for the C-47. Accordingly, the AAF rested high hopes on its development, but engineering difficulties so persisted that it did not get extensive use before 1944. Total acceptances reached only 3,144 by August 1945.[113]

The Douglas *C-54* (Skymaster) became the outstanding four-engine transport of the war. Known in its commercial model as the DC-4, the C-54 served chiefly on the long-distance hauls of ATC. Strictly a transport and cargo plane, which was not modified for troop carrier purposes, and would have been uneconomical in such a service, the C-54 was not available in large numbers until 1944.* Its most colorful achievement came no doubt on the "Hump" route to China, but it also cut down the great distances separating the United States from many other far-flung battle fronts.[114]

Among the bombers modified for transport service, first choice fell on the B-24, because of its range. Designated the *C-87*, the modified bomber performed important transport services for the AAF from the beginning to the end of the war. As the *C-109*, it was used as a tanker and hauled large quantities of fuel across the Himalayas from India to China.[115] Many unmodified B-24's saw unanticipated service as transports and tankers in theaters throughout the world, a notable example being the use of a wing of Eighth Air Force B-24's in September 1944 to haul gasoline for Patton's Third Army in France.

A variety of light utility aircraft carried the conventional symbol of the cargo plane, though the cargo carried was rarely heavier than

* The AAF accepted more than 1,000 C-54's before the war ended.

the baggage of some inspector or staff officer on a hurried mission. The need for such carriers during the early days of AAF expansion was met by the purchase of a wide variety of light commercial planes, which soon presented peculiar and serious problems of maintenance. In time, four planes in this class were acquired in quantity: the Fairchild *C-61*, a single-engine four-passenger transport; the Cessna *C-78*, a twin-engine transport version of the AT-17 trainer which could carry five passengers with baggage; the *C-64*, a single-engine plane designed as a "float and ski" freighter which was produced by Noorduyn Aviation Limited of Montreal and was used chiefly in arctic regions; and finally, and most satisfactory of all, the Beech twin-engine *C-45*. Its production was retarded because of the higher priority given to training planes, but the AAF eventually accepted 1,771 C-45's by the end of the war.[116] The importance of the transport plane to the operations of the AAF, whether as a carrier, troop transport, or long-range cargo carrier, is illustrated by the growing inventory of these planes. In July 1939 the AAF had only 118 transports, and on the eve of Pearl Harbor it had only 216. Thereafter the inventory rose steadily; by August 1944 the AAF had more than 10,000 transports on hand.

The glider was an important auxiliary of the troop carrier version of the transport plane. The Army had paid little attention to this sports craft until the Germans demonstrated in 1940–41 its utility for military operations. The Materiel Division began study of the engineering aspects of the glider in February 1941, and initiated procurement of gliders for training purposes in April 1941. Two months later, a design competition for cargo- and troop-carrying gliders was held, from which the Waco fifteen-place *CG-4A* emerged as the most satisfactory. Its procurement was undertaken early in 1942, and the whole glider program was steadily expanded as airborne operations grew in size and importance.[117] Although the CG-4A was frequently criticized after it appeared in the fall of 1942, it proved itself in airborne operations in Europe and Burma, where it was towed by C-47's or C-53's, and none of the other gliders developed during the war could be seriously considered as a replacement for it. It was made of wood, had no motor or armament, and carried one radio for communications. More than a dozen companies participated in its production, since the program—which included virtually all of the 15,000 procured—was too large for the Waco Company to handle alone.

Trainers

Almost 25 per cent of the grand total of planes accepted by the AAF through August 1945 were trainers—all told some 55,000 of them.[118] In contrast to the combat planes, their several qualities became little known to the American public, but their production necessarily held the highest priority during the earlier years of the AAF's extraordinary expansion. The peak of production was reached long before that of the combat types, and from November 1940 through February 1943 trainers constituted at any time more than 50 per cent of the total inventory of AAF planes. As the training commands cut back their programs in 1944, the percentage moved downward.[119] The primary trainer was a small, light plane designed for initial training in flight; the basic served in an intermediate stage to introduce the cadets to service-type planes; the advanced trainer served in the final stage of individual flight training to provide experience with planes of size and performance more nearly that of the combat models. Normally the combat model was introduced at the level of unit training.* But the regular AT planes were at times supplemented by old and obsolete models of combat aircraft employed for advanced training.[120] The complexity and high performance qualities of World War II combat models left no choice but observance of these successive stages in the training of aircrews.

Most of the training aircraft used were versions of commercial types standardized to permit uniform training methods and to reduce problems of maintenance. Even the advanced trainers were usually commercial models adapted for training purposes. The most important of the AAF's primary trainers during World War II were the Stearman *PT-13*, with its offspring, the *PT-17* and *-27*; and the Fairchild *PT-19* with its two variations—the *PT-23* and *-26*. The PT-13, a wood, metal, and fabric biplane, though first acquired by the Air Corps in 1936, was still regarded by the Training Command at the end of the war as the "best primary training" airplane ever developed. The PT-19 was developed before the war to meet the Air Corps' requirement for a monoplane PT. The Vultee *BT-13* and *BT-15*, which differed only in their engines, served almost exclusively as the basic trainers throughout the war. The outstanding advanced trainer was the North American *AT-6*, a single-engine, all-metal, low-wing mono-

* See below, pp. 567, 600 ff.

plane, known in the United States as the Texas and in Canada and the United Kingdom as the Harvard. The Beech Aircraft Corporation developed the *AT-7*, *-10*, and *-11* series of twin-engine advanced trainers, all of which were variations of the C-45. The AT-7 was used for navigation training and was an all-metal, low-wing monoplane. The AT-10 was the same plane constructed chiefly of wood and fabric and equipped with different engines, but it was not as satisfactory as the AT-7. The AT-11, equipped with guns and bomb racks, was used as a bombardment trainer. Other advanced trainers procured in smaller quantities were the Cessna *AT-8* and *AT-17*, both twin-engine planes.

CHAPTER 7

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THE QUEST FOR BETTER WEAPONS

IN THE late summer of 1945 the second in command of the AAF summed up the central lesson taught by the varied experience of the war years in the simple statement that the "first essential of air power is preeminence in research."[1] This observation represented no momentary response to the recent explosion of atomic bombs over Hiroshima and Nagasaki. Constant change had characterized the aerial weapon from the first, and the thought of those who held responsibility for its employment naturally rested upon an assumption that the ultimate limits of performance had yet to be reached. In prewar years the Air Corps, although it kept in close touch with technological developments in the aviation industry, had been unable to exploit the full resources available for the support of its developmental programs, but the pressure of the war years forced greater attention to research and development.

Before 1939 it had become painfully apparent to Air Corps leaders that the pace of aircraft development had reached a stage calling for closer attention to the role of research in building American air power. But the expansion program launched in 1939 necessarily placed first emphasis on the acquisition of planes in sufficient number to offset our potential enemies' time advantage. In circumstances requiring the most careful allocation of sharply limited resources, immediate large-scale production of the best contemporary models again and again had to be preferred to the expectation that far superior models might later be produced. General Marshall undertook to explain to Congress in January 1940 that no policy of mass procurement of the latest-type plane was possible "since there is always a later type being manufactured."[2]

The German victory in western Europe during the spring of that

year reemphasized the contrast between the mighty Luftwaffe and the still tiny Air Corps. President Roosevelt, while calling for 50,000 airplanes, warned Stimson and Marshall that no contracts should be entered into "from now on for either planes or engines or for the development of new types of planes or engines without coordinating this with the general program as a rule."[3] Arnold responded to the new pressures on 6 June by ordering a first priority for "the continuous production of current types of airplanes." He assured the Chief of Staff on 14 June that "every effort was being made to standardize equipment, increase production, expedite deliveries, and defer our present research and development." Simultaneously he warned his staff that the Army's interest was in planes to be delivered "within the next 6 months or a year, certainly not more than two years hence."[4] The Materiel Division at Wright Field received notice that research and development during fiscal 1941 must "of necessity be given a lower priority than the production program and that experimental contracts could not be permitted to interfere with or delay production."[5] This policy did not put a stop to all experimental work, but it did impose delays on more than one project.* During the summer, when deliveries of aircraft fell behind schedule, the manufacturers complained that developmental projects took the time of engineers needed to speed up production, and in September Arnold directed the Materiel Division to defer all such projects and to release the engineers until deliveries were once more up to schedule.[6] He apparently found acceptable, however, the division's report in October that production "*has been given first priority*" and that no further deferments of developmental projects could in any way expedite production.[7]

By the end of 1940 a more satisfactory balance between production and development was being sought. Robert A. Lovett on 30 December called for "all possible speed on advance research and experimentation" and for study of the need for additional research facilities.[8] And in April of the following year Arnold on a visit to Britain was greatly impressed by the progress of British research and the necessity of guaranteeing that the United States not lag behind the great air powers of the world in the quality of its equipment.[9] By this time England's improved military position and the progress achieved in America's production program made a change of policy possible. In

* Among others, the Curtiss XP-46, the Republic XP-47, the Lockheed XP-49, and the North American XB-28.

May 1941 the Materiel Division was in position to urge upon manufacturers the need for full exploitation of all experimental resources.[10]

The involvement of the United States in hostilities a little more than six months later necessarily renewed the need for production. Until the production peak was reached in 1943, the all too familiar dilemma of how to get "more and better" weapons often had to be resolved in favor of quantity rather than quality. But the AAF had a two-year start on its expansion program, and at no time after Pearl Harbor did it become necessary to resort to the drastic research and development cutbacks that circumstances had dictated in 1940. As the war's end approached, research and development stood in first priority.[11]

In retrospect two observations seem pertinent. Any decision to freeze aircraft models for purposes of mass production involves some sacrifice of advantages that might be gained by more research, which is merely to say that the critical decision in making an air force ready for combat must be a compromise between the demand for quantity and the requirement of quality. In view of the record, the decisions which shaped the growth of the AAF during World War II were sound. In certain areas, such as that of jet propulsion, the United States lagged behind other countries, and the AAF knew moments of the gravest apprehension because of this lag.* But in the end, events proved that the AAF had enough planes and that they were good enough to do the job. More than that could hardly be asked.

Organization for Research and Development

Traditionally, the Air Corps had depended chiefly upon close teamwork with the aviation industry for the development of its equipment. Through Wright Field agencies the Air Corps prepared detailed aircraft specifications, which were then passed on to the industry's engineers for the construction of experimental articles. In the final stage of testing those articles, Air Corps agencies necessarily assumed the ultimate responsibility. It was a usage proved by time and facilitated by a variety of close personal associations. Not unnaturally, it continued to be the chief dependence of the AAF throughout the war.

In October 1939 the Materiel Division of OCAC served as the key agency both in the specification of requirements and in the testing of new equipment. With all operational elements at Wright Field and only a small staff at Washington, the whole division was commanded

* See Vol. III, 659–60, 666, 743–45.

until March 1943 by a single chief, first, Maj. Gen. George H. Brett and later Maj. Gen. Oliver P. Echols. At that time, Wright Field became headquarters of the Materiel Command, which thereafter operated as a subordinate of A-4 of AAF Headquarters.[12] At Wright Field an experimental engineering section continued to serve as the hub of AAF research and development. Headed throughout the war by Brig. Gen. Franklin O. Carroll, this section coordinated experimental and testing work within the AAF. As projects multiplied, the Materiel Command acquired additional testing centers, of which the one at Muroc, California, became the most important.[13]

One of Wright Field's major activities centered in its experimental laboratory, but two other commands directed testing operations more closely allied to the tactical demands of combat. The AAF Proving Ground Command, dating from 1941 at Eglin Field, Florida, and commanded for the greater part of the war by Brig. Gen. Grandison Gardner, evolved from a small organization for the testing of armament into a command charged with a wide variety of testing services which focussed particularly on the suitability of equipment to the actual requirements of combat. Strictly speaking, the command's distinctive function was to find the answer to tactical problems, as in the preliminary testing of the effectiveness of fire bombing against Japanese targets and in the elaborate tests conducted in a search for the most effective means of attack upon German V-weapon launching sites in western Europe,* but naturally the results of such experiments served to lend direction to a variety of developmental projects.[14] On a lesser scale, the same may be said of the AAF School of Applied Tactics† at Orlando, Florida, established in 1942.[15]

It was only natural that the Air Corps should enjoy virtual independence in the testing of its equipment, but a growing autonomy in the determination of its requirements spoke eloquently of the changing status of the air arm within the War Department. The Air Corps began its great expansion in 1939 still subject to the usual procedures for review of its programs by superior agencies of the War Department. But these procedures proved so slow that Arnold complained to Marshall on 1 March 1940 that "more time is consumed by the

* See Vol. III, 97–99; V, 610.

† One informed observer expressed in retrospect the view that these two organizations had been designed to break the influence of Wright Field on the development of tactics through its control of aircraft development.

Army in the preliminary phases than is actually allowed the aeronautical industry for its preparation of designs and submission of bids in accordance with Circular Proposals."[16] The President's call for a 50,000-plane program soon gave such importance to the Air Corps' development as to assure faster action by the General Staff, and after March 1941 G-4 no longer reviewed AAF programs of research and development. In fact, little effective control existed thereafter below the level of the Chief of Staff himself.[17]

This autonomy, though established well before our entry into the war, was generally limited to aircraft development. The AAF continued to depend upon the Ordnance Department for the provision of bombs, rockets, guns, and ammunition; upon the Chemical Warfare Service for incendiary materials; upon the Corps of Engineers for construction equipment; and upon the Signal Corps until the last year of the war for the development of radio and radar equipment. All this imposed upon the AAF a continuing necessity for coordination of its programs with a variety of agencies subordinate to the War Department. The increased independence of the air arm greatly facilitated the negotiations necessarily involved, and in most areas of development existing arrangements served to relieve the AAF of additional burdens. But in one area—radar development—the AAF continued to urge its right to independent control of developments peculiar to aeronautics. Not until October 1944 did the AAF succeed in acquiring responsibility for radar; the transfer of personnel and facilities was completed by late January 1945.[18] In 1943 the War Department, increasingly alert to the overriding significance of research, established a New Developments Division. It was charged with very broad functions but concerned itself chiefly with gathering information on new and unconventional weapons, particularly guided missiles, and with arbitrating "competition between those tactical and procurement arms seeking to obtain a portion of the responsibility for developing and applying such weapons."[19]

Within the Air Corps before 1939 the determination of requirements depended upon processes less formal and systematic than could be expected to meet the need thereafter. General Brett was quick to point out the necessity for a "fixed procedure" to determine "fixed requirements" that would serve as "a predetermined goal" of the Air Corps' developmental programs.[20] As the prewar expansion got under way, the determination of requirements was centered in the Plans Section of the OCAC and in the Air Corps Technical Committee, a

board consisting of representatives of the OCAC, GHQ Air Force, the General Staff, and the Materiel Division. The committee's deliberations were necessarily slow, however, and after December 1939 the Chief of the Air Corps worked directly with his Plans Section and the Materiel Division to determine requirements.[21] In June 1941 the Air Council, a new committee of ranking air officers, undertook the task of shaping over-all policy, but it did not survive the coming of the war.[22] The frenzied activities of the months immediately following Pearl Harbor apparently called for swifter decisions than could be made by a deliberative body.

The Air Staff moved promptly to brief its engineers on the new requirements of active warfare. Within two weeks of the Japanese attack, the project engineers at Wright Field were summoned to Washington to be "re-aligned on our strategic plans and problems in general terms . . . in order [that] they will know what our requirements will be in the future."[23] Strategic plans through the first months of hostilities were far from firm, however, and the engineers complained that necessary information on the development of plans reached them less promptly than was desirable.[24] At AAF Headquarters the Director of Military Requirements, Brig. Gen. Muir S. Fairchild, undertook to "control" a program of development which in its execution was charged primarily to the Materiel Command. In conference with representatives of the command in July 1942, he explained the need to draw upon the actual experience of tactical groups, a function his own office was in position to perform, and proposed the organization of a committee composed of representatives of the Air Staff and the Materiel Command.[25] This body, known as the Air Materiel Planning Council and consisting of seven representatives of the Air Staff and one of the Materiel Command, was charged to review the "characteristics of experimental, service test, and production aircraft with the view of insuring the continuous integration of changing tactical and strategical requirements with aircraft development and production."[26] But after several months of activity the council went the way of its predecessors, and normal staff and command relations were substituted. When AAF Headquarters was reorganized in the spring of 1943, the Requirements Division of AC/AS, Operations, Commitments, and Requirements (OC&R) inherited the function of prescribing "what" was wanted by the AAF. On occasion, OC&R showed some tendency to encroach on the function of AC/AS, Materiel and Services (M&S) and tell it "how" to do its job,

but consultation between the two staff agencies usually ironed out all such difficulties. With time it became possible to strengthen the latter agency by assigning it and the Materiel Command an increasing number of officers having operational experience in the several theaters.[27]

OC&R drew from strategic plans and records of combat experience the information necessary for a stated program of requirements. M&S made available the technical knowledge that permitted refinement of qualitative requirements into specific characteristics. Daily contacts, committee meetings, and the exchange of reports on activity gave the organization a necessary flexibility and coordination. Periodic reviews of projects under way made possible the elimination of those which were not "paying their freight or which do not give hopes of immediate or near future dividends."[28] Frequently Wright Field would suggest items for development to the Requirements Division and ask whether a requirement existed for such items. The Air Communication Office and a special civilian consultant group under Dr. Edward L. Bowles played key roles in determining requirements for radar and other electronic aids.[29] For a period of several months in 1944 an informal committee on AAF development, broadly based in its representation of interested agencies, reviewed the whole subject of future research and development.[30]

As the war progressed and production drew abreast of demand, AAF leaders showed some tendency to allow scientific and technical possibilities, instead of strategic and tactical need, to shape developmental plans. Late in 1944 Arnold appointed a Scientific Advisory Group of distinguished civilian scientists under the chairmanship of Dr. Theodore von Karman for the purpose of assembling "ideas for new weapons, possibly of the 'Buck Rogers' variety, for use during this war or for post-war development." No idea, however impractical at the moment, was to be ignored so long as it was "not opposed to [the] natural laws of science."[31] Thus did Arnold, who had developed a certain affection as well as respect for "the longhaired boys," undertake to peer into the future of aeronautical development.

Cooperation with Other Agencies

Because it had to share the nation's aeronautical resources with the air arm of the U.S. Navy, the AAF probably had more interests in common with the Navy than it had with the rest of the Army. Through its Bureau of Aeronautics and Bureau of Ordnance, the Navy conducted programs which sometimes complemented and some-

times competed with those of the AAF. Many of the projects conducted by the two services overlapped, but such duplication of effort was defended on the ground that healthy competition could produce a better product.[32] The Aeronautical Board, a prewar agency representing the Air Corps and the Navy, helped to standardize some of the equipment used by the two services and to provide encouragement for coordination of developmental programs. But the AAF rejected Navy proposals in 1940 and 1944 that the two services establish a committee for closer coordination of their research and development programs, and no such agency was established during the war.[33] If the AAF complained of a tendency by the Navy to monopolize the developmental resources of certain industrial firms, it is likely that the Navy had cause for similar complaint against the AAF. There were occasions when production for one service appeared to suffer because of developmental work being done for the other in the same plant. In exchange of information between the two air arms the Navy probably benefited the more because of its vigorous and aggressive policy of assigning liaison officers to every possible AAF project while limiting access to its own projects.[34]

The NACA continued to be the most important government agency engaged in fundamental research for the advancement of aeronautical science. In response to the growing demands made on it after 1939, NACA expanded its organization and contributed significantly to most of the technical achievements of the war period. Under the pressure of military urgency, it may have become too much involved in applied research at the expense of its prime mission of fundamental research. The AAF enlarged its liaison staffs with NACA, creating permanent offices at the various NACA facilities to represent it in "all transactions and all matters of common interest with the NACA Laboratories." The relationship between the two organizations was necessarily close, and the AAF generally supported the NACA vigorously in its requests for facilities, funds, personnel, and priorities.[35]

Other government agencies contributed much to the scientific and technical excellence of the AAF during the war. The National Bureau of Standards participated in projects of great importance to air operations, especially those concerned with fuzes and guided missiles. Like the NACA, the Bureau of Standards conducted its research on behalf of other agencies which made funds available to it for continuing or special projects.[36] The Civil Aeronautics Administration also per-

formed developmental research of importance to the AAF. Its projects were concerned chiefly with the human problems of flying and with technical development of aircraft instruments, airport devices, charts, and other aids.[37]

A new and especially important government agency for research and development came into existence on 27 June 1940—the National Defense Research Committee. Modeled after the conspicuously successful NACA, the eight-member committee headed by Vannevar Bush was directed to "correlate and support scientific research on the mechanisms and devices of warfare, except those relating to problems of flight included in the field of activities" of the NACA.[38] A year and a day later the committee became a part of the newly created Office of Scientific Research and Development (OSRD), of which Bush became director with increased responsibilities and powers.[39] Although aeronautical research had been exempted from the province of NDRC, it directed research projects of great importance to the AAF, many of whose greatest needs—communications equipment and armament, for instance—did not fall within the scope of aeronautics. Between June 1940 and March 1944, the OSRD undertook some 125 projects on behalf of the AAF, and in December 1944, it was conducting 79 such projects, not including 32 additional ones sponsored by the Signal Corps for the AAF. Liaison officers from the Materiel Command followed these projects, and the OSRD made available to the AAF, as to all other agencies dealing with it, reports of projects in progress.[40]

The AAF had opposed the creation of an over-all research agency only two months before the NDRC was established, and its initial reaction to the new agency was mixed. Although it was officially welcomed by General Arnold,[41] some of the officers in the Materiel Division were skeptical of the need for such an organization. It was felt that the Air Corps could do well enough in a continuing collaboration with NACA and industry.[42] The exclusion of aeronautical problems from the jurisdiction of the NDRC eliminated a potential conflict of authority, and the scientists who served with OSRD helped soon to make the AAF a willing, even eager, collaborator of the OSRD.[43] In September 1944 the AAF protested that plans to begin the demobilization of OSRD upon the defeat of Germany were premature, and urged that operations be continued until after the defeat of Japan.[44]

The AAF also profited greatly from the policy of close collabora-

tion between the United States and Great Britain in the exchange of scientific and technical information. This policy, one of the most significant aspects of the Anglo-American coalition, had its origins in the prewar release of some of the latest Air Corps models for use by the British.* Such release, of course, did not in itself imply the adoption of a policy of full and free exchange of information, but the RAF was necessarily apprised of technical developments within the Air Corps, which in return enjoyed the benefit of combat tests on some of its more hopeful projects.[45] If these mutual advantages served to lay the foundation for an increasingly close collaboration, they by no means eliminated at once the customary restrictions on the release of classified information. Early in 1940 the British agreed to accept American military observers, but these were as limited in their access to information as were comparable British missions in the United States. Only at the governmental level could a decision be made to remove the traditional security restrictions.

Lord Lothian, British Ambassador to the United States, and his scientific attaché, Archibald Vivian Hill, had been convinced by May 1940 that a scientific interchange would be mutually beneficial and had urged the necessary action on their government. Before the end of July 1940 President Roosevelt in response to a message from Lord Lothian had approved the proposal.[46] In a swift follow-up the British dispatched to Washington in late August a mission including Canadian members and headed by Sir Henry Tizard, scientific adviser to the Ministry of Aircraft Production. The mission was authorized to exchange secret data on communications, radar, underwater detection, fire control, turrets, superchargers, rockets, explosives, and chemical warfare. The interest of the American military services in these important fields was obvious, and they readily joined the NDRC in discussions with the British. Each country revealed much information of value to the other, and the "result was a great stimulus to research on new weapons on both sides of the Atlantic."[47] At that time, the British unquestionably had more to offer than did the Americans.

As a result of the visit of the Tizard mission, arrangements were made for a continuing exchange of information among Great Britain, Canada, and the United States. When these arrangements proved inadequate to the need, the passage of the Lend-Lease Act early in

* See Vol. I, 127–35.

1941 helped to overcome the initial British hesitancy to accept proposals for the exchange of scientific offices in the two capitals. In March 1941 President Conant of Harvard met a cordial reception as he established an office of NDRC in London, and in April the British Central Scientific Office was established in Washington. Thereafter, both countries expanded their scientific missions, and the NDRC later established in England laboratories which were of great assistance to the AAF.[48]

Air Corps missions to Great Britain, composed of some of the best officers in the service, followed each other in rapid succession during 1940–41.* In May 1941 the Army established a permanent military mission (Special Observer Group) in London, with an air officer in command. SPOG's air staff section eventually evolved into the Air Technical Section of Headquarters, European Theater of Operations in July 1942 and, under the able leadership of Brig. Gen. Alfred J. Lyon, and later Col. Howard G. Bunker and Col. Donald L. Putt, served as the AAF's permanent technical liaison office in the United Kingdom until the end of the war.† The AAF continued to send special technical missions to Great Britain throughout the war to secure information on particular projects.[49]

Meanwhile, the British had maintained technical personnel in the United States since early in the war. Combined British-American agencies were established in Washington in 1940–41 to coordinate problems of production and standardization of equipment, and these inevitably became concerned with aeronautical research and development. The most important of these agencies for the AAF was the Joint Aircraft Committee, originally established in September 1940.[50] All concerned agreed on the desirability of pooling British combat experience and American technology as early as possible in the development of materiel, and AAF policy eventually settled on the mock-up‡ stage as the point at which the British would be permitted to examine new projects. Special British missions visited the United States during the course of the war, supplementing the work of the resident missions.[51]

* Among the Air Corps officers who visited Engand during 1940–41 were Arnold, Brett, Spaatz, Eaker, Royce, Saville, Chaney, Emmons, Gardner, Carroll, and Marriner.

† In February 1944 it was transferred to Headquarters, United States Strategic Air Forces in Europe.

‡ A mock-up is a full-scale ground model of an airplane, made of wood or some other material, and is used by the engineers to check questions involving access, space, arrangement of installations, visibility, etc.

The exchange of information between the AAF on the one hand, and the RAF and the Ministry of Aircraft Production on the other, was beset by the same difficulties which characterized virtually every other phase of the Anglo-American wartime collaboration. The British, standing in the front line against the Germans, alone until December 1941, felt, perhaps justifiably, that they were fighting for the United States as well as for themselves, and that it was to our interest to supply them with the best weapons in quantity. If, during the early years of the war, they assumed the role of senior partner in the firm, they had a strong foundation in experience which the United States could not yet match. On the other hand, the AAF detected early and complained often of British disinclination to grant the Americans full access to technical information and to materiel under development. The British made similar complaints about the AAF, and it is evident that both countries showed some inclination to retain for themselves as long as possible the fruits of their more advanced scientific and technical thought. AAF resistance to more active British participation in its aeronautical research and development program stemmed from the fear that British, rather than American needs, might shape that program. It stemmed, too, especially in the early years, from a desire in the Air Corps to enhance its own prestige and to attain a stature at least equal to that of the RAF.[52]

In spite of the caution with which both countries conducted the interchange of information, it was equally notable for its large measure of success. In 1940–41 the British made available to the AAF a number of outstanding items of equipment, including the Rolls-Royce Merlin engine, radar for aircraft detection, and the Whittle jet-propulsion power plant. By September 1940 the AAF had permitted the British access to the latest American aircraft models and equipment, with the exception of the Norden bombsight (withheld at the insistence of the Navy) and certain turret data. After Pearl Harbor the British had much freer access to AAF projects, including eventually those for the development of jet propulsion and guided missiles.[53]

Programs

The tremendous expansion of research and development in the United States between 1940 and 1945 was especially notable in the field of aeronautics.[54] The nation's annual expenditures for this purpose rose from approximately $250 million in 1939 to more than

$800 million in 1945. In 1944 the federal government was spending some $600 million* on research in the physical sciences alone.[55] For that fiscal year the AAF budgeted a total of $121,647,605 as against the $3,574,290 allotted to research and development in 1939 and the $10 million in 1940; in addition, the Navy's Bureau of Aeronautics received almost $80 million and the NACA over $45 million for aeronautical research during the same year.[56] Other agencies—among them the Ordnance Department, Signal Corps, and Bureau of Ordnance—also expended large sums on work bearing directly on problems pertinent to the AAF. In all, it is likely that almost half of the total research and development appropriations of the federal government for the war years was spent by or on behalf of the air arms of the Army and Navy. The AAF alone spent more than 25 per cent of the total expended by the federal government on research and development between 1939 and 1944.

By far the greater part of the funds expended went to contracts with industrial firms. Of the $418,755,020 spent for research and development by the AAF between 1939 and 1944, $337,448,692 underwrote research contracts with industry; for university contracts the total was only $2,453,659. Expenditures within the AAF reached $53,759,308, a sum that does not include costs of administrative overhead. The OSRD, apparently with the agreement of the other government agencies, monopolized university resources to the extent of almost 98 per cent of the dollar value of all government research and development contracts with universities. OSRD spent $220 million with the universities and $110 million with industry. Of the $95 million expended by NACA, almost all was directed to the support of work conducted within NACA's own establishment.

The generous appropriations of funds during World War II permitted the AAF, the Navy, and the NACA to expand their research and development establishments beyond their fondest prewar dreams. Between 1939 and 1944 the capital investment in plant at Wright Field grew from about $10 million to nearly $54 million, divided almost equally between technical equipment and laboratory structures. Besides adding at least four testing stations in various parts of the country, in October 1944 the AAF also acquired the Signal Corps facilities at Wright Field. The expansion of test facilities at Eglin Field and at Orlando, Florida, was extensive after 1940, almost $20

* This does not include the cost of the Manhattan Project.

million being spent on construction at Eglin for the four years 1941–44.[57] The NACA's growth was of special importance to the AAF. In addition to greatly enlarging its facilities at Langley Field, Virginia, NACA constructed new laboratories at Moffett Field, California, and at Cleveland, Ohio. NACA's $70 million plant in 1945 was certainly the finest of its kind in the United States and possibly in the world.

In shaping its own programs of research and development, the AAF depended at first upon the traditional device of a special military board—a representative group of qualified officers appointed to study a particular problem and to make recommendations. Thus the Kilner Board in 1939 had undertaken to provide a blueprint for Air Corps research and development through fiscal 1945.* As early as April 1940 Arnold felt it necessary to appoint a new board, headed by Maj. Gen. Delos C. Emmons, to "revise the Five-Year Experimental Program."[58] A secondary responsibility for review of the current modernization program, in the circumstances, tended to dominate the work of the board, which promptly determined that the "main factor for immediate consideration" was the "determination of priorities of various types of aircraft for immediate expansion procurement."[59] With the aid of Wright Field engineers, who already had undertaken a review of the priorities set in the Kilner report, the Emmons Board agreed in June 1940 on the following priorities: for aircraft engines, units ranging in horsepower classification from 1) 1,700–2,400, 2) 2,500–4,000, and 3) 4,000–5,500; for aircraft, 1) a heavy bomber with range of 5,333 miles, 2) a two-engine interceptor, 3) a medium bomber with 2,667-mile range, 4) an escort fighter with 1,500-mile range, 5) a single-engine interceptor, 6) a dive bomber (adaptation of Navy type), 7) a light bomber, 8) a long-range bomber, 9) an observation plane, and 10) a two-engine trainer.[60] On receiving the report, Arnold promptly interchanged the first and fourth priorities, giving the escort fighter first place.[61]

His action was symptomatic of the influences that during this period of rapid expansion would force repeated adjustment of priorities and make of any over-all plan nothing more than a general guide to ultimate objectives. Thereafter, Wright Field engineers opposed all proposals for the drawing up of new programs, including a sug-

* See above, pp. 178–80.

gestion that the Air Corps join with the Navy's Bureau of Aeronautics in requesting NACA to prepare a five-year research and development program for the Army and Navy.[62] Normal staff procedures were soon substituted for the special board under circumstances which made changes of priority the rule rather than the exception. Sometimes changes were directed by Arnold; sometimes they were suggested by the Materiel Division as a result of engineering experience. In November 1941 the OCAC reported to the Office of the Secretary of War that the highest priority in the development program was being given to long-range heavy bombers—the XB-29 and XB-32. Ranking next were pursuit aircraft, engines, superchargers, propellers, fire-control apparatus, and detection equipment.[63]

By December 1941 Wright Field was directing a developmental program which included some 2,000 projects.[64] Requirements fluctuated rapidly with the coming of the war, and in an effort to provide guidance to the program, the AAF appointed another board in January 1942 to review "recommendations and plans relative to the development and procurement of aircraft required under the Victory Program."[65] Under the chairmanship of Col. Earl L. Naiden, A-3 of the Air Staff, the board considered characteristics for transport and cargo aircraft, a 10,000-mile bomber, a bomber with a range between that of the B-29 and the 10,000-mile bomber, and various other categories of aircraft. But its report could be regarded as a recommendation of no more than temporary utility. The volume of research and development projects grew so great as 1942 progressed that the Materiel Command had difficulty in knowing the background and keeping abreast of the status of even its major projects. In an effort to establish necessary controls, the Engineering Division compiled and published on 1 July 1942 the first edition of "Research and Development Projects of the Experimental Engineering Section." Issued semiannually thereafter, this publication became the standard guide to developmental projects in progress.[66] The exigencies of war produced a sharper distinction between short-term and long-term projects, and emphasis on weapons that would be of use in "this war, not the next one," tended to push aside projects for less immediately needed equipment. A list of "super-materiel projects" drawn up for the Chief of the Air Staff by the Materiel Division of AC/AS, MM&D in January 1944 indicated the following priorities: 1) fighter range-extension tanks, 2) guided missiles, 3) flying cloth-

ing, 4) the XP-75, 5) computing gun sights, 6) fire control for B-29's, and 7) 20-mm. gun turrets.[67] Of these, only one—guided missiles—could be regarded as a long-term undertaking. Periodic reviews by representatives of AAF Headquarters and the Materiel Command eliminated the least promising projects and readjusted the order of priorities from time to time in accordance with changing demands. These reviews were full-scale examinations of the program, sometimes lasting as long as two weeks and involving scores of experts from every field of research and development.[68]

By the spring of 1944 a change was to be noted as the AAF turned its attention increasingly to postwar plans. In May a program, designated Project B-7 and covering the fiscal years 1946–50, called for annual expenditures ranging from $125 million in 1946 to $80 million in 1950 and provided for some expansion of facilities at Wright Field. The program provided for expenditure of the largest single allocation of funds for experimental and developmental aircraft. The major fighter projects would include a jetpropelled stratosphere fighter, a transonic experimental plane, and a supersonic experimental plane. Among the bomber projects, there was a provision for an experimental medium jet bomber and for design studies of attack and heavy jet bombers and a supersonic bomber.[69] In a memorandum to General Marshall in May 1945, General Arnold outlined the awesome potentialities of future AAF research and development. Long-range experiments "in the field of advanced physics with elements capable of releasing unmeasured forces . . . revolutionizing the field of explosives to the ultimate point of ending human survival" were but a part of the destructive forces research promised to unleash—all of them "peculiarly adapted to air employment."[70]

The B-36

Among the wartime projects which did not come to fruition in time to affect the combat activity of the AAF, special interest attaches to the effort to develop an intercontinental bomber. The idea of such a bomber had intrigued Air Corps leaders for several years prior to 1941; both the XB-15 and XB-19 had been planned on a scale and with a range far in excess of that achieved by any of the World War II bombers. An 8,000-mile bomber found place in the reports of both the Kilner and Emmons Boards, but developmental resources were concentrated first on the interim goal of a 5,000-mile

bomber—which is to say, on the B-29 and B-32. By late 1940, however, the world situation was peculiarly favorable to a renewed effort in search of a truly intercontinental bomber. Should Germany force Britain to capitulate, the United States probably would be left to face its potential enemies alone and without oversea bases. Accordingly, on 1 January 1941 the Assistant Chief of the Air Corps, General Spaatz, directed the Air War Plans Division to review the problem of bomber development with attention to a possible "radius of action such as Point Barrow to Berlin."[71]

Three months later, on 11 April, the Air Corps invited Boeing and Consolidated to submit preliminary design studies for a bomber of intercontinental range, and on 3 May Consolidated submitted proposals for a high-wing, single-tail, pressure-cabin bomber with a range of 10,000 miles carrying a 10,000-pound bomb load.[72] The spectacular success of the German invasion of Russia during the summer months prompted a new study of long-range bomber requirements in the event of Britain's collapse. By 14 August, when the problem was reviewed at a special meeting attended by Lovett, Brett, then Chief of the Air Corps, and representatives of Wright Field in addition to a number of key staff officers, four companies were already at work on designs: Boeing, Consolidated, and Douglas on conventional planes and Northrop on a tailless flying wing. The magnitude of the project—Echols commented that no company could build even the prototype of such a plane in less than two and a half years—and the necessity for an overriding priority at the expense of other important developments were fully appreciated, but the word given the Wright Field representatives was to expedite the project "to the greatest possible degree."[73] A new directive to the Chief of the Air Corps called upon him to take prompt steps to assist the four interested companies by giving them the most up-to-date information on desired characteristics.[74] Plans included provision for the development simultaneously of an escort plane of the bomber type,* but defensive firepower in the bomber itself ranked second only to range in the preliminary specifications.[75]

In October 1941, after reviewing data submitted by Boeing, Douglas, and Consolidated, the Air Corps awarded a contract to the last-named for two experimental six-engine bombers, designated XB-36, with delivery dates set at thirty and thirty-six months later.

* See above, pp. 217–18.

A cost-plus-fixed-fee contract with Consolidated was signed on 15 November 1941.[76] Northrop, which had begun work on its flying wing (XB-35) in September, received a contract for the first experimental article one week later.[77] By August 1942 the two projects had passed the mock-up stage, and Wright Field felt that "both airplanes are feasible and that both projects can be brought to a successful conclusion." The XB-35 showed "considerably more promise in performance and bomb-range capabilities on the basis of gross weight," but continuation of the XB-36 was justified as insurance against trouble with the unconventional flying wing. Engineering difficulties were attributed partly to a personnel shortage, a deficiency the Materiel Command undertook to remedy by securing additional engineers, especially for Northrop, the smaller of the two companies. Transfer of the B-36 project from the Consolidated plant at San Diego to Fort Worth imposed a further delay, but the company expected the plane to fly in May 1944. Arnold on 28 September 1942 directed that the two planes be given the "highest priority."[78]

By July 1943 the potential characteristics of the XB-36 had become reasonably clear. It was to have a design gross weight of 265,000 pounds and was to be powered by six 3,000-horsepower Pratt & Whitney engines. With a pressurized cabin and heavy armament, including 37-mm. guns and .50-caliber machine guns, it would have a range of 10,000 miles with 10,000 pounds of bombs and 4,600 miles with a maximum bomb load of 72,000 pounds. The XB-35 would be smaller, with a gross weight of 155,000 pounds and a range of 7,600 miles carrying 10,000 pounds of bombs. It would be powered by four 3,000-horsepower Pratt & Whitney engines and would have a high speed of 418 miles per hour.[79] As of 24 December 1943 the Materiel Command estimated that the engineering of the XB-35 was 29 per cent complete and that the first plane could probably fly in April 1945.[80]

On the initiative of Under Secretary of War Patterson and with the authorization of the Secretary of War, Arnold in June 1943 ordered the procurement of 100 B-36's. Consolidated was given a letter of intent in July 1943, and on 19 August 1944 Patterson approved the contract for 100 B-36's at an estimated cost of $154,250,000 plus a fixed fee of $6,170,000 for Consolidated.[81] But development of the XB-36, and the XB-35* as well, continued to lag: as

* The AAF had contracted for two XB-35's and thirteen YB-35's.

the tempo of the war quickened and Japan was brought within range of the B-29, production requirements for other types of planes—particularly the B-29 and the B-32—were given higher priorities which siphoned off engineering and production resources from the bigger bombers.[82]

As the end of hostilities approached, postwar plans for American air power gave first place to a strategic striking force. Both the B-35 and the B-36 were still under construction; the former made its first flight on 25 June 1946, the latter on 8 August.[83] But advance studies already had picked the B-36 as the plane around which to build the postwar air force,[84] and subsequent tests confirmed the decision.

Jet Propulsion

The United States lagged behind Germany and Great Britain in the development of jet propulsion, and this failure has been properly described as the "most serious inferiority in American Aeronautical development which appeared during the Second World War."[85] The principle of propulsion by reaction is an old one, but until the 1930's gas turbine and aircraft design were insufficiently advanced to encourage the development of a jet-propulsion unit. Sustained work on the problem began at approximately the same time—1935-36—in Germany and Great Britain. The original British jet engine, developed by an RAF engineering officer, W/C Frank Whittle, powered an aircraft in flight for the first time on 15 May 1941. The Germans had made the first jet-powered flight on 27 August 1939, but the British and Germans were actually more nearly abreast in their progress than this time difference would suggest.* Both countries put a few jet fighters into combat as early as 1944, though their numbers were insufficient to have significant effect. No American jet fighters flew in combat during World War II.

The Air Corps had been aware of the potentialities of jet propulsion before the war, and in 1939 the Chief of the Air Corps reported that the National Academy of Sciences had been requested to study the problem of "compression-ignition engines and rocket or jet propulsion as a sole prime-mover and as an augmenter to the main power plant, to improve aircraft performance." Jet research was under-

* The Italians also worked on jet propulsion in the late 1930's and eventually produced the Caproni-Campini CC-2, which flew for ten minutes on 27 August 1940 and once again on 30 November 1941, this time from Milan to Rome. The Italians made no further progress of significance in the field of jet propulsion during World War II.

taken by the California Institute of Technology under contract with the National Academy of Sciences, but this was a long-range project from which the Air Corps apparently expected no early returns.[86] In 1940 the Air Corps sought to persuade the NDRC to assume responsibility for the entire jet-propulsion problem, "figuring that the increased funds, facilities, and scientific personnel available to the NDRC might serve to give the necessary impetus to research work on this problem, at least to get it up to the point where the Air Corps could take over and attempt a test installation on some type of aircraft." But the NDRC was reluctant to assume the responsibility, arguing that it belonged properly to the NACA.[87] Two aircraft manufacturers—Northrop and Lockheed—had launched independent investigations into the development of gas turbines for use in aircraft. The Northrop development, which was intended to drive the propeller on the plane rather than to provide full jet propulsion, was supported by a joint Army-Navy development contract awarded in 1941. Lockheed's project, begun in 1940, looked to the development of a gas turbine jet-propulsion engine. Preliminary plans were completed in 1941, and in 1943 the AAF gave the company a developmental contract.[88]

Intelligence reports in early 1941 of jet-propulsion progress in Germany impelled the Air Corps to make another effort to persuade the NDRC to undertake this important work, but that agency once more refused to enter the field except insofar as it affected its study of rockets and guided missiles. Meanwhile, an additional $8 million was authorized for accelerating the research undertaken by the California Institute of Technology.[89] But nothing concrete could be expected from this project for perhaps two years, and General Arnold asked the NACA to study the subject. In March 1941 the NACA established a special committee on jet propulsion under the chairmanship of William F. Durand which included representatives from the Air Corps, the Navy, the Bureau of Standards, Johns Hopkins University, Massachusetts Institute of Technology, and the manufacturers of turbines—General Electric, Westinghouse, and Allis-Chalmers. It has been asserted that the regular aircraft engine manufacturers were not included because Arnold feared that they might be opposed to unorthodox power-plant developments.[90] According to Dr. Jerome Hunsaker of the NACA, the "regular aircraft companies were approached but were not one bit enthusiastic" about joining the committee.[91]

When Arnold visited England in April of that year, he was told of the existence of the Whittle engine by Lt. Col. Alfred J. Lyon, Air Corps technical liaison officer in England, and D. Roy Shoults, technical representative of the General Electric Company. Arnold, on seeing the engine and the plane in which it had been installed, was tremendously impressed and determined "then and there" that he "must get the plans and specifications of that jet plane back to the United States."[92] Fortunately, the British were willing to make the Whittle engine available to the United States, and it became possible for the Air Corps to plan a comprehensive program for the development and production of jet engines in anticipation of receipt of the plans for the Whittle engine. In June 1941 Arnold requested that the Durand committee give first priority to jet-propulsion devices for assisting take-off of heavily loaded aircraft and second priority to development of devices and engines as primary sources of power. The Durand committee decided that the three turbine companies should proceed with studies of turbojet engines and in September recommended that contracts be signed for development of engines by all three companies. Allis-Chalmers and Westinghouse projected turbojet engines, while General Electric initially worked on a turboprop* engine.[93] In September Secretary of War Stimson and Sir Henry Self, Director General of the British Air Commission, agreed on the conditions under which the Whittle engine would be made available to the United States. The AAF agreed to special precautions for the preservation of secrecy, among them severe restrictions on the number of individuals and industrial firms to be involved in work with the engine.[94] One result was to keep from Northrop and Lockheed, which built the AAF's first successful jet plane, full information on the AAF's interest and activity in this field until 1943.

On 4 September 1941, at a meeting with General Arnold, representatives of the General Electric Company agreed to undertake production of the Whittle engine and to carry on further research to improve its design and performance. On the following day the Bell Aircraft Company agreed to produce three articles of a twin-engine plane to be powered by the jet engine. General Electric agreed to build fifteen engines, to be designated "I" superchargers.† Bell, which

* The turboprop, as the name suggests, combines jet propulsion with a propeller.

† For security reasons the early jet engines were called superchargers.

was selected partly because of its proximity to General Electric, was to collaborate closely with the latter.[95]

The British dispatched production drawings of the Whittle engine (W2B) which reached General Electric at the beginning of October 1941. Although the company found it necessary to make changes in the original design, its first engine was ready for testing in March 1942.[96] Meanwhile, Bell was building the XP-59A* to carry the new engine, and on 18 October 1942 at Muroc Dry Lake, California, it made its first flight, powered by two I engines and piloted by Col. Laurence C. Craigie. Additional engines and aircraft were ordered from the two companies, whose prosecution of this project the AAF regarded as worthy of commendation, and testing continued at a rapid pace. But the P-59, although an important step in AAF jet development, did not have the performance desired and was relegated to the status of a training plane by 1944.[97]

This initial success in adapting the Whittle engine to AAF needs, however, had led to the assumption that "important tactical possibilities are imminent."[98] In October 1942 Col. Benjamin W. Chidlaw directed that the Materiel Center at Wright Field establish an organization to coordinate and supervise all aspects of the jet-propulsion program.[99] At a meeting with Navy and NACA representatives in November 1942, the AAF agreed to exchange progress reports with the other two. In addition to the I engines at General Electric and the XP-59A at Bell, NACA sponsored for the AAF the I-16 and TG-100 engines at General Electric. The Navy had four jet-propulsion projects under way. The AAF urged still closer collaboration with the British, who had at least a half-dozen jet engines under development, but NACA and the Navy, which was particularly secretive about its projects, rejected the proposal. The problem of bringing the major engine manufacturers—Wright, Pratt & Whitney, and Allison—into the picture was also discussed, and the conclusion was reached that although they were overloaded, they would have to be brought in sooner or later. Whatever the attitude of these companies had been in the spring of 1941, they since then had made many "indirect approaches to the Materiel Command as to possibility of participation in event any sizeable jet program were planned."[100]

* Also for security reasons, the AAF had decided to call the first jet airframe the XP-59A. The original XP-59 was a conventional experimental plane, and it was thought that the use of the same designation would hide the true identity of the new model.

Retention of the Bell and General Electric projects in a Secret classification had hampered the AAF in its effort to attain an effective organization of the over-all effort. By 1943 hundreds, if not thousands, of people at Bell and General Electric were working on the project. Accordingly, and sensibly, the security classification was lowered to Confidential.[101] The way was now open to bring Northrop and Lockheed into full collaboration. Northrop had been authorized in January 1943 to proceed with construction of the XP-79, a small flying-wing type rocket-propelled interceptor that was destined never to fulfill its original promise and was written off after the war.[102] In May 1943 the Materiel Command invited Lockheed to submit a design for a fighter plane built around the British Halford engine, by DeHavilland, which the British then considered to be their most promising jet engine and had agreed to make available for production in the United States. Allis-Chalmers undertook production of the engine, and plans were made to use it in the first P-80's, which Lockheed was to produce. Although the contract for the XP-80 was not actually approved by the War Department until 16 October 1943, Lockheed already had begun work on the plane and completed it in 145 days.[103]

The XP-80 made its first flight at Muroc Dry Lake, California, on 8 January 1944. The single Halford H-1 engine delivered 2,250 pounds of thrust at sea level, and during its subsequent flight-tests the plane attained speeds of 500 miles per hour in level flight, the first AAF plane to attain this distinction.[104] But it was already apparent at the beginning of 1944 that for a long time it would not be possible for Allis-Chalmers to produce the Halford engine in quantity; nor would it be possible to get large numbers of the engine from the British. Under these circumstances, the AAF decided to use another engine in the XP-80 and settled on the General Electric I-40, an improved unit which had its first tests in January 1944 and appeared to be capable of delivering 4,000 pounds of thrust, considerably more than the Halford. Lockheed was asked to build two XP-80A's to accommodate the I-40, and thirteen YP-80A's were subsequently added to the contract. The final engineering development and production of the I-40 received the highest priority.[105] The XP-80A made its first flights with the I-40 engine in June 1944, by which time the AAF had already placed production orders for 500 planes. Unfortunately, the engine had a much higher rate of fuel consumption

than had been anticipated, a defect which materially reduced the range of the plane.[106]

Anticipating that these engine difficulties would be overcome, the AAF proceeded with plans for expanding production of both the engine and the airframe for the P-80A. The Allison plant at Indianapolis became associated with General Electric in the production of the I-40, and North American made its plant at Kansas City available to supplement Lockheed's airframe production at Burbank, California.[107] The P-80 program was assigned top priority, given in fact equal footing with the B-29 in February 1945. In January 1945 AAF Headquarters had made plans to place the P-80A into combat by the fall of the year, and 115 P-80's had been accepted by the AAF by the end of 1945, but only 45 were actually on hand and none of them saw combat service.[108]

Development of additional jet engines and aircraft had, of course, been continuing at a rapid pace while the AAF was trying to get the P-80 into production. In January 1944 the Materiel Command had on order experimental numbers of eight types of jet-propulsion engines other than the I-40, and three aircraft other than the XP-59A and XP-80. Attaining speeds of 500 miles an hour was certain, but reports of German progress up to 650 miles per hour spurred the AAF to further activity. During the course of 1944 NACA and the Materiel Command laid the groundwork for the transonic and supersonic aircraft which became a reality after the war.[109]

General Electric, profiting immensely by the head start it had gained in its work with the Whittle engine, dominated the American jet-engine field at the end of the war. It had in production or under development the I-40, TG-100 (turboprop), and TG-180 engines. The Westinghouse 19A, which was first flown in 1944 in a Navy FC-1 Corsair, was the only engine of original American design to be flown before the end of the war. Although successful, the engine was small, developing less than 1,500 pounds of thrust, and was not put into quantity production. Other engine projects were the Northrop Turbodyne, the Lockheed L-1000, and the Pratt & Whitney PT-1 turboprop, none of which were flown before the end of the war. The Pratt & Whitney engine was the only fully private venture represented among the jet engines developed during the war.[110]

Although fighter aircraft had been the first to be equipped with jet engines, the AAF was fully aware of the importance of acquiring

jet bombers. By the end of 1944 the AAF had contracted for three jetpropelled bombers—the Curtiss-Wright XA-43, the Douglas XB-43, and the North American XB-45, all to be powered by the General Electric TG-180 engine. Only the B-45 was ever produced in numbers greater than test quantity. By the end of the war other jet bombers under development were the XB-46, -47, -48, and -49, of which only the Boeing B-47 survived the experimental and test phases to be put into production in the postwar period as the AAF's first strategic jet bomber.[111]

The AAF pushed the development of jet fighters with increasing vigor as the end of the war approached. The Consolidated-Vultee twin-engine XP-81 first flew in February 1945 but was never put into quantity production. Bell constructed the XP-83, powered by two I-40 engines, but it did not meet the needs of the AAF. Design of the McDonnell XP-85, a small parasite fighter to be carried inside the B-36 bomb bay, was begun before the end of the war, but only a few postwar articles were produced. The single-engine XP-84 Thunderjet, which the AAF regarded as the most promising successor to the P-80, was not flown until after the war was over, when it attained a speed of more than 600 miles per hour. The outstanding American fighter of the postwar years, the F-86 Sabrejet, was in the design stage on V-J Day.[112]

Several factors help account for the United States lagging behind Great Britain in turbojet development at the end of World War II. The AAF and the Navy, particularly the latter, did not permit, in fact discouraged, collaboration among the companies participating in the jet-propulsion program. This was done largely for the sake of secrecy and was in direct contrast to Britain's practice of encouraging a full exchange of information among her own agencies. The American military services, moreover, gave the highest production priorities to existing engines, thus effectively preventing the established aircraft engine companies from entering the jet-propulsion field. The British, on the other hand, brought their engine companies into jet-propulsion work as early as 1942, and according to an AAF authority, this collaboration was a major reason for British success.[113] As for Anglo-American collaboration on jet propulsion, the United States got more than it gave. Although American progress in jet propulsion during 1941–45 was in many ways comparable to that of the British for the same period, it must be conceded

that this was so only because the British had made available in 1941 the design and actual articles of the Whittle engine. The successful jet engines produced by General Electric through 1945 were all adaptations of the Whittle engine.[114]

Guided Missiles

Guided missiles constituted the third of three major AAF programs on the frontiers of research and development. More than any other AAF program, it promised to have a revolutionary effect on future warfare.

Americans had discerned the promise of the guided missile at least as early as World War I, when the Air Service had tested power-driven "flying bombs" or "torpedo planes," developed by a group of outstanding engineers including Charles F. Kettering. Efforts to continue this work during the years between the wars were ineffectual, largely because of lack of funds.[115] In 1938 the Air Corps' interest in remotely controlled missiles was revived, and during the next two years General Arnold explored the possibilities with Kettering, then vice-president of the General Motors Corporation. A design competition for aerial torpedoes in 1939 produced no satisfactory data, but in February 1940 the War Department approved a set of characteristics for an aerial torpedo which was to be capable of striking a target with a half-mile diameter at a range of twenty miles. One year later the AAF contracted with General Motors for ten such aerial torpedoes, subsequently designated controlled bombs, power-driven. Actually, these were to be remotely controlled aircraft carrying bombs in the fuselage. It was expected that they would be small and inexpensive.[116]

The contract with General Motors for the GMA-1 power-driven bomb initiated a guided-missiles program which grew steadily in scope and importance during succeeding years. Development of these missiles was destined to fall, in general, into three major categories. The first included all types of power-driven bombs, ranging from the embryonic GMA-1, through the "war-weary" B-17's and B-24's, to the jetpropelled JB-2's, which were copies of the German V-1. Various types of controls, including preset and remote, were used to guide these ground-launched missiles to their targets. The second group of missiles were glide bombs launched from aircraft. In their simplest form these were bombs, equipped with wings and gyro-

stabilizers, which would glide into the target after being launched from a plane. In their more advanced forms, the bombs would be controlled from the launching aircraft by means of radio or radar. The third major group of missiles consisted of standard bombs which could be controlled from the launching plane in azimuth and/or range. Bombs from this last group were the only guided missiles used in combat in more than experimental quantities by the AAF.

Interest in power-driven bombs persisted throughout the war, even though the GMA-1, often referred to as the "Bug," was abandoned in August 1943. The "Bug" was tested extensively, beginning in 1941, but the problem of controlling it was never successfully solved. Furthermore, its capabilities—speed, range, and bomb load—became steadily less impressive as the tactical capabilities of all types of aircraft increased. Other power-driven bomb projects begun during 1942 and 1943 included Fleetwings' XBQ-1 and XBQ-2A and Fairchild's XBQ-3. These were all conventional planes capable of carrying bomb loads ranging from 2,000 to 4,000 pounds, but none of them met AAF requirements. They were too expensive and their tactical utility was limited because they required clear visibility, fighter protection, and highly trained crews. In short, they appeared to have no real advantage over the piloted bombing plane and had the disadvantage of being expendable. For these reasons and because other developments of greater utility and promise were under way, the BQ program did not survive the war.[117]

In 1944 the AAF showed a great deal of interest in the possibility of using obsolescent combat planes, known as war-wearies, as power-driven bombs. By that time a large number of B-17's and B-24's had outlived their usefulness in combat. It seemed desirable to make some effective use of them against the enemy, and the extent to which the Eighth Air Force by this time had resorted to an area type of attack against German cities prompted a suggestion that the war-wearies might be expended as power-driven bombs. The Materiel Command at home and the U.S. Strategic Air Forces in Europe undertook experiments with plans to load the plane with up to 20,000 pounds of explosives. The idea was that a pilot would take the plane into the air, set all the necessary controls, and then bail out. Thereafter, the plane would be controlled to the target from another aircraft. But the control equipment behaved erratically in tests conducted against German targets in the fall of 1944. Accordingly, it

was decided to switch to ground radar control of the "Weary Willies," as the planes had come to be known. The revised project was given the highest priority in the guided-missiles program in October 1944. NDRC joined in the search for effective control apparatus in the hope that the problem might be solved in time for use against German cities during the winter when flying conditions would be none too favorable for standard bombing procedures. Again, however, the program never got beyond the experimental stage; by the end of the year its priority had been drastically lowered. It was discovered that war-weary aircraft were usually not in condition to permit their use for the purpose, and there was no point in diverting other bombers in good condition from their standard use.[118] In 1945 the search for a power-driven bomb turned to the fighter plane and the possibilities of using P-38's and P-47's were investigated. It was suggested that the planes be launched rather than taken aloft by pilots and that a form of ground radar control be used to guide the plane. The termination of the war killed this project before it had reached the developmental stage.[119]

Meantime, the German use of the V-1 jetpropelled pilotless bomb against England, beginning in June 1944, had given a powerful impulse to AAF efforts to develop a tactically useful guided missile. The AAF reacted immediately to the news of the German attacks on southern England by concentrating its main effort in the guided-missiles field toward development of a similar weapon. Prior to this time the military services and the NDRC had already made plans to apply jet propulsion to some of the guided missiles under development. But this work was still in the planning stage in June 1944, and the AAF desired a retaliatory weapon that could be produced in large numbers with a minimum of delay.[120] This desire reflected no grave concern over the current tactical situation, for the Allies enjoyed a strategic position, particularly in the air, which was far superior to that of the German. Both Spaatz and Eaker, from their commands in the ETO and MTO respectively, advised that they could "foresee no immediate requirement for the use of pilotless aircraft." But there was concern to catch up with a development promising serious potentials for the future. Already, too, the problem of control of guided-missiles development had become a subject of debate within the War Department. The AAF believed that it would be in a strong position if it could develop and actually use in combat

as spectacular a missile as the V-1.[121] Vannevar Bush subsequently concluded that such a weapon "probably would at no time have been worth its cost, which was not inconsiderable when all factors such as handling and launching sites were included."[122] But at the time the AAF felt otherwise. Its top leaders, including Robert A. Lovett, personally supervised the initiation of the program. While Northrop received a contract to develop a jetpropelled pilotless aircraft superior in range, accuracy, and bomb load to the German weapon, the chief emphasis was placed on reproduction of the German V-1, an already proved tactical weapon.[123] Using parts salvaged from crashed V-1's in England, Wright Field engineers built a duplicate of the propulsion unit used in the "flying bomb" and tested it in August 1944, less than three weeks after the first parts were brought from England. Encouraged by the rapid progress, the AAF ordered 1,000 of these JB-2's, or "Chinese copies of the buzz bomb" as they were called. By 8 September the first complete JB-2, an all-steel jet-powered monoplane, had been assembled at a plant of the Republic Aviation Corporation;[124] the first JB-2's were launched at Eglin Field, Florida, in October, and tests continued for many months thereafter.[125]

Technical problems, particularly in launching the weapon, still remained to be solved, but the AAF decided to ask for a major production program. In October 1944, Arnold directed Wright Field to procure enough JB-2's to permit a launching rate of 1,000 per month, and even though it was well known that production facilities to meet the requirements for the rockets used in launching the missile did not exist, the AAF decided in January 1945 to expand the program enormously. Lt. Gen. Barney M. Giles, Chief of the Air Staff, requested that the War Department establish overriding priorities which would permit production of JB-2's in sufficient numbers to allow 500 launchings per day by 1 February 1946 or sooner. But the request was denied by the General Staff on grounds which seem to have been sufficient, from both the logistical and strategic viewpoints. Production of JB-2's on the scale requested by the AAF would have seriously interfered with the war effort: it would have required a reduction of 25 per cent in the field artillery program and 17 per cent in bomb production, it would have cost one and one-half billion dollars, and it would have required 25 per cent of all shipping space to the United Kingdom.[126]

After restudying the question in the light of its effect on other production, the AAF reduced its requirements to a comparatively modest 1,000 JB-2's per month, one-fifteenth of its earlier requirement. The total production requirement was set at 10,000. The uncertainties connected with production planning had communicated themselves to potential manufacturers, who became reluctant to participate in the program, which proceeded slowly. The end of the war in Europe made it clear that no immediate use existed for the JB-2, and the War Department directed that the production goal be lowered to a maximum of 5,000. Developmental work continued and test launchings, using a variety of devices, had reached 213 by 8 August 1945. Production contracts were terminated on 15 September 1945, after 1,391 JB-2's had been delivered. Developmental work continued until 1946.[127]

Meanwhile, Northrop had proceeded with the development of its flying bomb, a jetpropelled flying-wing type. The JB-1 was launched in December 1944, but the experiment revealed an incompatibility between airframe and engine. The airframe was then modified, but the new version—now designated the JB-10—proved to be little more satisfactory than its predecessor. In view of progress on other missiles, the AAF in March 1946 dropped it from the research and development program.[128] One other jetpropelled guided missile—the JB-3—was still under development at the end of the war. This was an air-to-air missile, developed by the AAF in conjunction with the NACA. Full-scale testing did not begin until after the end of the war.[129]

Glide bombs constituted the second major category of guided missiles developed by the AAF during the war. The AAF's interest had been prompted early in 1941 by information of British work on "aerial gliding torpedoes, gliding bombs, and aerial mines." Although the information secured from the British was not complete, General Arnold directed AAF engineers to proceed with the development of a glide bomb. Because torpedoes were also involved, the Navy became interested in the project and agreed to test such equipment as might be used in connection with torpedoes.[130]

In contrast to the V-weapons subsequently developed by the Germans, which were surface-to-surface missiles, the glide bomb was to be launched from the air. The problem broke down into two parts: the development of a winged structure to carry the bomb and

of controls to direct it. Wings for a glide bomb were procured as early as June 1941 and had been tested by the end of the year. More difficult was the problem of control. Maj. George V. Holloman, in charge of the project, concentrated his attention therefore on the development of a radio device that might guide the bomb against predetermined points up to a distance of thirty miles or of some seeking device through which the bomb might be made to home on the target itself. The utility of such devices was not limited exclusively to glide bombs, and the work was consequently of importance for most types of missiles then under development.[131] But Arnold was impatient for a missile which would be available for combat use in the near future. After a personal review of the project in July 1942, he ordered that development of complicated controls be stopped until a simple glide bomb with wings and an automatic pilot had been built—one that could glide into a large built-up industrial area. A lack of precision shown in tests of the resulting bomb in August perturbed members of the Air Staff at AAF Headquarters, but officers in charge of the project replied that it had never been assumed that the bomb could be used for pinpoint bombing. They ventured the opinion that it would be possible to "place one hundred per cent of them [the bombs] inside a city the size of Dayton, Ohio, from any altitude up to thirty thousand (30,000) feet, and . . . from altitudes up to five thousand (5,000) feet, the greater percentage of them could be placed inside a large factory area." After further consideration, AAF Headquarters directed in October 1942 that the glide bomb, designated GB-1, be produced in quantity and that a group of B-17's equipped to launch them be ready for action in England before the end of 1942—a time schedule that proved decidedly optimistic.[132]

The GB-1 consisted of a 2,000-pound bomb attached to a high-wing structure with two booms and a tail surface. Controls, carried by the bomb itself, were preset and could not be adjusted by the launching airplane. Because of its simplicity and lower cost, Arnold decided to give this type of bomb priority over power-driven missiles.[133] Revised plans called for use of the GB-1 from the United Kingdom in 1943. Planes and missiles were available before the end of that year, but the new bomb was not tried in combat until 25 May 1944, when 116 bombs were launched against Cologne. Results were unimpressive and no more attacks were attempted. The Eighth Air Force had never been enthusiastic about the GB-1, which was

satisfactory only for area bombing, and had stated in May 1943 that it had no use for it at the time. The one combat test seemed to confirm the conclusion that the bombers could accomplish more with conventional bombs. Subsequently, the whole GB-1 program was canceled.[134]

Other projects included a glide torpedo—the GT-1—which was tested before the end of 1943. The Far East Air Forces used it in the Pacific during 1944–45, but on only a few occasions, the chief objections being the lack of range when carried by the B-25 and its usefulness against large targets only.[135] Two remotely controlled bombs were also developed, after cooperation among a number of agencies, including NDRC, the Radio Corporation of America, and the National Bureau of Standards. The GB-4 combined radio control and visual observation, while the GB-8 combined radio control with television. Progress on these two bombs had been delayed because of the priority accorded the GB-1, and not until the summer of 1944 were they tested in combat in Europe. The results were unsatisfactory and quantity procurement of the bombs was canceled. The AAF and the Navy sponsored a number of other glide bombs during the war, using a variety of control or seeker devices. None of these were used in combat by the AAF, although the Navy made limited use of two radar-controlled glide bombs—the "Pelican" and the "Bat."[136]

In a third category of guided missiles, the controlled vertical bomb proved useful. The first of this type, the azon bomb (VB-1) could be controlled in azimuth only. Developed under the auspices of the AAF by NDRC, the azon was a 1,000-pound general purpose bomb fitted with an extended tail which carried a flare, a radio receiver, a gyrostabilizer to prevent rolling, and rudders for steering to right or left at the will of the bombardier in the launching plane. The bomb was intermittently used in the European and Mediterranean theaters in 1944–45 without conspicuous success. But it was employed with excellent results against bridges in Burma late in 1944 and during 1945. In little more than two months the 7th Bombardment Group claimed 27 bridges with an expenditure of 459 azon bombs, and direct hits with 10 to 15 per cent of the bombs.[137] When the war ended, the AAF dropped its plans to make extensive use of azon, perhaps because of the progress by that time achieved with a variety of other such projects. Since 1942 experiments had been under way with a bomb that could be controlled visually in range as well as in

azimuth.[138] Seeking and homing devices were also being tested on a variety of the standard vertically dropped bombs.[139] At the end of the war the Army Air Forces had a guided-missiles program which included air-to-surface, surface-to-surface, surface-to-air, and air-to-air missiles.[140]

The return of peace removed considerations of short-term expediency which frequently had affected the program during the war and opened the way for the establishment of objectives that were truly revolutionary in their implications for the future of warfare. If during the heat of battle some officers, especially those charged with immediate combat responsibilities,[141] tended to dismiss all "Buck Rogers" devices in favor of weapons of proved utility, the German V-1 and V-2 and the American A-bomb had destroyed the very grounds upon which this skepticism rested. It was clear enough now that even the wildest flight of the imagination might hold a suggestion that no nation dared ignore.

No less clearly perceived were the implications affecting service interests. The guided missile, even more than the airplane, called into question traditional assumptions regarding the assignment of functions to the respective armed services. The problem was twofold: 1) who would develop the weapon? and 2) who would use it?—with the answer to the latter tending to govern the decision on the first. In 1943 the Ordnance Department of the Army had begun studies which led early in 1944 to a contract with the California Institute of Technology for the development of a long-range rocket, and in February 1944 the AGF had requested Ordnance to develop a guided antiaircraft missile.[142] In August of that same year AGF submitted to the AAF for comment a tentative guided-missiles program which included ground-to-air as well as ground-to-ground missiles. The Assistant Secretary of War for Air, Robert A. Lovett, had previously expressed his concern about the possible duplication of AAF programs by the Army Service Forces performing development work for the AGF and had suggested that Arnold look into it. Arnold and his staff initially felt that there was no threat of duplication since Ordnance was working on rockets and the Materiel Command on pilotless aircraft. Where the two programs overlapped, they had a "common laboratory meeting ground" at the California Institute of Technology. "There appears to be ample room in the rocket field," Arnold informed Lovett on 19 August 1944, "for both Air and Ground Forces." But Echols and the Materiel Command disagreed and predicted that there would

be duplication which would result in competition.[143] It was not long before such duplication became apparent to the AAF. The development of ground-to-air missiles, in particular, became a subject of controversy, since the AAF had for some time been seeking control of antiaircraft artillery. Development of a successful antiaircraft guided missile by the AGF would insure it of continued control of the antiaircraft function. Furthermore, the AAF believed that it might be excluded from developmental work in this field if the concept of the operational user controlling development of the weapon were followed. When it considered also the possible development of a long-range self-propelled rocket by the Ordnance Department, the AAF saw a distinct threat to its strategic bombing mission. By early September Arnold, Giles, and the operations staff of AAF Headquarters had recognized the far-reaching significance of the coming struggle for control of the guided-missiles program.[144]

On 7 September 1944 Giles proposed to the Under Secretary of War that the Materiel Command "continue to direct the development of guided missiles, including any joint development." He contended that "guided missiles generally fall within the developmental jurisdiction of the Army Air Forces." At the same time Giles proposed to the Ordnance Department that it participate in a joint program with the AAF, which would "monitor the program" in order to avoid duplication and competition.[145] The AAF failed in this effort to secure control of guided-missiles development although the Chief of Staff had indicated in July that the AAF should have responsibility for research and development of all guided missiles. The AGF and the Ordnance Department were successful in arguing their case in the conferences on the subject which took place during September. On 2 October the Chief of Staff directed that the AAF have research and development responsibility for guided or homing missiles launched from aircraft and for such ground-launched missiles as depended on the lift of aerodynamic forces. The Army Service Forces would have responsibility for ground-launched missiles which depended on momentum.[146]

This directive provided only a temporary solution to the problem, which had ramifications outside of the Army. The NDRC had a major role in the basic research for guided missiles, and there was competition for resources not only between the ASF and the AAF, but with the Navy. No effective coordination of the guided-missiles program was attained although in January 1945 the JCS established the Guided

Missiles Committee of the Joint Committee on New Weapons and Equipment. This committee had representatives from the Army, Navy, NACA, and OSRD and concerned itself with broad policy direction of the guided-missiles program.[147]

As development of guided missiles quickened, the problem of responsibility for operational employment of the weapons became of major importance since the fate of several combat arms of the Army might depend on the solution. The question was thoroughly explored during the spring of 1945, but no definite decision was reached. In June the Deputy Chief of Staff decided to withhold any decision on assignment of operational employment of guided missiles because they had not yet been developed to the point where it was possible or necessary to make the decision. Meanwhile, research and development responsibilities would remain as previously allocated.[148] The end of the war found the AAF still engaged in attempting to secure a key position in the guided-missiles field against competition from other elements of the Army. The problem of duplication of effort and competition with the Navy for resources was also a continuing one.

In another field of research and development—atomic energy—the AAF had no part whatsoever during World War II, except to carry the atomic bomb to Hiroshima and Nagasaki. Only a few AAF officers, including Arnold, of course, had any knowledge of the atomic-energy project prior to the formulation of plans for dropping the bomb. At the end of the war, the AAF had no plans or programs for atomic-energy research and development. But staff officers were quick to recognize the implications of atomic energy and to raise the proper questions about it. In August 1945 AC/AS-4 asked the Requirements Division of AC/AS-3 what would be the effect of atomic-energy development on the guided-missiles program.[149] Shortly after V-J Day, Maj. Gen. Edward M. Powers, AC/AS-4, proposed to the Chief of the Air Staff that the AAF "establish formal channels at the earliest practicable time by which sufficient technical data on atomic energy can be disseminated within the Army Air Forces to permit research and development leading to possible applications to existing, as well as future aeronautical weapons and equipment."[150] Before the end of 1945 the initial steps were taken to revise the AAF research and development program to include applications of atomic energy. These applications promised to include, in addition to atomic warheads for projectiles, propulsion of aircraft and missiles.[151]

CHAPTER 8

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PRODUCTION PLANNING AND ORGANIZATION

THE 5,500-airplane program launched by the Air Corps in the spring of 1939 guided its expansion for more than a year. The goal for 30 June 1941 called for the organization and equipment of 24 combat groups and a number of additional squadrons, with a total of 1,900 first-line airplanes.

In the more than eight months that elapsed between the German attacks on Poland and France, the United States took no further decisive steps to rearm itself. While some military leaders, particularly General Marshall, recognized the need for a still greater expansion of the armed forces, they were not in a position favorable for pushing their views. President Roosevelt and congressional leaders viewed with reluctance the prospect of persuading the American people of the necessity to undertake rearmament beyond that already under way. As late as April 1940 the House of Representatives seemed ready to reduce the War Department's request for obligated funds by 9.5 per cent for fiscal year 1941. Indeed, during the early months of 1940 the Air Corps had to make a vigorous defense of its request for a small number of additional four-engine bombers to be included in the 1941 budget estimate.[1] It is evident, too, that military leaders themselves had some difficulty in shaking off the habits of thought shaped by long years of peacetime budgets. Accustomed to think in small terms—whether of dollars or of manpower—they understandably displayed some reluctance to ask for sums which would "choke the patient," as General Marshall later put it.

But once the tide of Nazi aggression began to engulf western Europe, there quickly developed among all segments of American society a demand for a large and rapid, indeed immediate, expansion of the armed forces. This demand focused especially on the Air

Corps, which because of its hitherto small size and the technically complicated character of its equipment faced a more difficult problem of adjustment than did any other arm. Popular impatience, which more than once found expression in Congress, took little account of difficulties that had led the Air Corps to shape its plans with a view to the steady expansion of a balanced air force.[2] When the President on 16 May 1940 issued his call for a 50,000-plane program, the Air Corps had just completed its study of a War Department proposal of the preceding March that first-line combat-plane strength be increased from 1,900 to 2,700—this to be accomplished within the limits of the 5,500-plane program.[3] The result may be instructive to the lay reader and helpful to an understanding of the complex problems with which the Air Corps struggled in its effort thereafter to keep up with the demand for expansion.

On the face of it, such a proposal might seem to involve no more than an increase by 800 of the number of combat planes at the expense of other types. But training requirements for manning the additional combat planes, it was estimated, would raise the Air Corps' requirement for training planes by an additional 1,792 trainers. To provide adequately for a reserve and replacement of the new force of 800 planes would add 394 more planes of combat type to the program, for a total of 1,194 combat aircraft. With the addition of incidental requirements for other types of aircraft, the grand total exceeded 3,000 planes—a total of course that could not be accommodated within the existing 5,500-plane program.[4] Should the decision favor this increase, the Air Corps proposed to add eighteen to the twenty-four groups currently planned.

Any doubts that may have existed as to the reaction of the War Department were immediately removed by the President's call for a force of 50,000 planes—a figure approximately equal to the total aircraft production of the United States since the Wright brothers' first flight at Kitty Hawk in 1903.* Twelve days after the President's message, the Chief of Staff on 28 May approved the Air Corps' plan for an operating force of 2,726 combat planes, a goal to be attained by 31 December 1941 instead of June 1942, as originally had been suggested.[5]

* For purposes of contrast it may be of interest to note that almost 300,000 planes were built in the United States between 1940 and 1945, three-quarters of them under AAF cognizance.

It seems clear enough that the "fantastic" goals set by the President in May 1940 had not been suggested by any responsible officer in the War Department. Sentiment there had favored further expansion, but objectives tentatively set seemed extraordinarily modest by comparison with the goals the Army, and especially the Air Corps, was now called upon to attain within theretofore unthinkable time limits. As staff officers hurried to make the necessary adjustments, programs succeeded programs, none of them destined for completion before being replaced by still more ambitious goals.

The President on 28 May announced the appointment of a National Defense Advisory Commission (NDAC) charged with initiating the country's defense mobilization. William S. Knudsen, the member responsible for production, brought a new type of embarrassment to the armed services with his persistent question: "How many pieces do you want?"[6] Army and Navy conferees agreed that the division of the 50,000 planes should be 36,500 for the Air Corps and 13,500 for the Navy—an arbitrary division made under the intense pressure to "get going" which then prevailed in Washington. For production-planning purposes, Arnold presented Knudsen with a listing by type of the 36,500 planes for the Air Corps on 5 June, calling for 26,500 tactical planes and 10,000 training planes. The enumeration of the tactical planes by types was, of course, highly tentative and underwent numerous changes in succeeding months and years, as did every subsequent aircraft production program.[7]

It was impossible to fix upon any firm program of expansion which could be expected to last for any period of time.[8] This was true not merely because the planners changed their minds from time to time, but also because many factors beyond the control of the military exercised a profound effect on both over-all and particular munitions programs, especially the aircraft program. Foreign orders had already tied up a substantial portion of American aircraft production capacity, and with the fall of France the needs of the British became still more desperate and urgent. Their claim on American aircraft production was generously honored by Roosevelt, sometimes to the dismay of Marshall and Arnold. The uneven acceleration of aircraft production also made it difficult to plan programs, while strategic and tactical uncertainties hindered attainment of a realistic breakdown of the 36,500-plane program. Educated guesses became the only recourse in this period, giving way to more definite and reliable plans as experi-

ence and events provided the data on which to base such plans and programs.

As the result of pressure from Knudsen and from the office of the Assistant Secretary of War, on 13 June 1940 the Chief of Staff estimated that aircraft production requirements for the Army would range up to an annual production rate of 36,000 by 1 April 1942.[9] At the same time, the Air Corps raised its goal for combat planes from the 2,726 adopted only a few weeks previously to 7,378.[10]

The First Aviation Objective

Knudsen had warned earlier that it would take two and one-half years to produce 50,000 planes, and this prediction, coupled with the desperate needs of the British, led to a downward revision of the Air Corps' goal. On 18 June 1940 the President indorsed a program calling for 18,000 aircraft and 30,000 engines by 1 April 1942, plus an annual productive capacity of 18,000 planes for the Army by that date. These planes were to be over and above those already on hand and on order.[11] On 26 June 1940 the Chief of Staff approved a plan intended to serve as the initial step toward the 18,000-plane air force. Known as the First Aviation Objective, this program called for the Air Corps to have by 1 April 1942 a total of 12,835 aircraft of current types, of which 3,873 were to be in tactical units, 2,131 in reserve, and 6,831 were to be training planes. The Air Corps would eventually reach the strength of fifty-four combat groups.[12] In order to meet the goals set in the First Aviation Objective the Air Corps sought and received approval for procurement of 14,394 airplanes as part of the War Department munitions program. This was actually the President's 18,000-plane program minus 2,181 planes previously included in appropriation legislation passed on 13 June and minus 1,425 planes deferred by the Bureau of the Budget.[13]

A recapitulation made in July showed the following summaries:

Planes on hand as of 30 June 1940	2,755
Planes on order as of 30 June 1940	2,829
Plane purchases authorized by Congress	4,247
Planes included in WD Munitions Program as of 30 June 1940	14,394
Total planes on hand, on order, and being considered for procurement	24,225

It can readily be seen that the total fell short of the 36,500 planes envisaged as the Army's share of the President's 50,000-plane program. The Air Corps anticipated that the President would submit to Congress future estimates for the remainder of the 36,500-plane program.[14] It is also apparent that the more than 21,000 planes included in this procurement scheme would provide far more than was needed to meet the First Aviation Objective of 12,835 aircraft. Higher objectives would have to be authorized by the War Department if the Air Corps were eventually to reach the size contemplated by the President. The War Department had not yet authorized the Air Corps to go beyond the 54-group program, but the Air Corps projected a 98-group program in July. At that time, the various programs, related to combat aircraft strengths, stood as follows:[15]

No. of Combat Planes	*No. of Combat Groups**	*Completion Date*
1,965	25	1 April 1941
2,726	41	1 October 1941
3,873	54	1 January 1942
7,378	98	Fiscal Year 1942

* The number of groups for these programs varied slightly from time to time, depending on whether transport groups were included in the total.

The achievement of these goals on anything like schedule was recognized as highly unlikely, partly because of the high priority accorded British claims on American production. In a meeting on 23 July 1940 between representatives of the American services and of the British Purchasing Commission it was agreed that "the procurement of airplanes and engines during the next two fiscal years . . . should be coordinated to permit an unified effort." The British already had 8,275 planes on order in the United States, and it was stipulated that they should be allowed to order 6,118 additional planes. This meant that the British would be given a higher priority for aircraft than the Army or Navy, which would have to schedule their production over a longer period of time. The allocation and delivery schedule reflected this priority:[16]

	30 June 1940 to 1 Apr. 1941	*1 Apr. 1941 to 1 Oct. 1941*	*1 Oct. 1941 to 1 Apr. 1942*	*Total by 1 Apr. 1942*
Army	6,882	3,548	2,454	12,884
Navy	1,923	1,555	2,730	6,208
British	4,094	4,686	5,595	14,375
TOTAL				33,467

The agreement, applying to deliveries on all aircraft programs under way, was substantially modified in succeeding months as circumstances dictated, but it provided the basis for the first over-all aircraft production schedule, Report No. 8 submitted in August by the Aeronautical Section of the NDAC.

On 9 September 1940 Congress passed legislation which brought to almost $2.5 billion the amount appropriated or authorized for the purchase of planes by the Air Corps since 13 June 1940. The bills provided for the purchase by 30 June 1942 of 18,641 planes of which 11,447 were combat models.* The Air Corps had let contracts for these by 30 October.[17]

With procurement plans thus geared to a rapid expansion of the aircraft industry under schedules that would bring peak production in 1942, the problem of how to maintain a high rate of production thereafter tended to take first place in U.S. defensive preparations. As Lovett later put the problem, the maintenance of a productive capacity was "a truer measure of air power than the number of planes at some given moment."[18] Once the industry had produced the planes ordered by the Army and Navy, what then? To maintain the Air Corps and the Navy air arm under other than war conditions would require a production rate only a fraction, probably between one-fourth and one-fifth, of the actual operating strengths of the services. What was to become of the excess productive capacity which would have been created? Aircraft manufacturers would need to know before the summer of 1941 what would be required of them after June 1942 if they were to be expected to maintain the highest possible capacity.

To Air Corps leaders it seemed unthinkable, in the light of world conditions, that aircraft production should not be maintained at a high level indefinitely. At the end of August 1940 Arnold told his staff that "we are practically on a war-time footing."[19] Subsequently, he urged upon Patterson the need for maintaining the production of the aircraft industry at a high level beyond 30 June 1942, and suggested that an additional 15,000 planes be produced during fiscal year 1943. These planes, he asserted,

> must be secured regardless of what is done with the airplanes we now have on hand. . . . The surplus planes . . . should be taken care of by sale to South

* The planes actually procured under appropriations legislation usually did not coincide with the number provided for because adjustments by type and model were frequently made.

American countries, giving them away, or melting down to secure raw materials for building other planes. It makes no difference what disposition is made of these surplus planes, so long as industry is kept working at full speed without interruption.[20]

In the end, it was judged that a further expansion of the Air Corps, rather than the junking of surplus planes, offered the better solution to the problem.

As plans for additional expansion took shape, the Air Corps pressed claims for substantial increases in the category of heavy bombers. During October it suggested a program for the production of 12,000 two- and four-engine bombers. Marshall was skeptical of the need for so many bombers but supported construction of the plants to produce them. The President questioned the advisability of including four-engine bombers in the mass-production program but was convinced by the arguments advanced by the Air Corps through Patterson and Knudsen.[21] On 16 November 1940 Roosevelt approved the first step in this direction—a program for the annual production of 3,600 bombers—1,200 four-engine and 2,400 two-engine.[22] Meanwhile, on 31 October, General Marshall had notified Patterson that the "annual production rate of 36,000 military type planes directed by the President is believed to be, in the light of world conditions, justified as a precautionary measure." Accordingly, the War Department approved an Air Corps program for production of 12,000 more aircraft, including all major types.[23]

While all estimates of rates of production to be attained by early 1942 were optimistic (Marshall mentioned a rate of 32,400 by 1 February 1942), and the production of the planes already contracted for would therefore take longer than anticipated, the need for continued procurement was appreciated by Congress. By July 1941 cash and contract authorizations covered the procurement of the 1,425 planes deferred from the previous September, the 3,600 bombers approved by the President in November 1940, and 12,856 more planes requested by the Air Corps. The addition of these planes to previous programs brought the Army procurement program approximately to the 36,500 planned a year before. Between them, the Army and the Navy had received either the funds or the authorizations to procure the 50,000 planes called for by the President in May 1940.[24]

Concurrent with the effort to increase aircraft production and maintain it at a high level, the Air Corps moved to expand its strength beyond the fifty-four combat groups authorized in June 1940. In No-

vember 1940 the Secretary of War directed that the 54-group program be completed without stop and that plans be made for the organization of additional groups. In December, General Marshall notified Assistant Secretary of War Patterson that "requirements so far as can be determined at the present time provide for equipment for 54 tactical groups and six transport groups, with a reserve believed to be sufficient to provide for the equipment of 40 additional groups."[25] After further study, the Chief of Staff approved a Second Aviation Objective on 6 March 1941. This program, providing for 84 groups and 7,799 combat planes, was to be initiated as soon as the 54-group program had been completed.[26]

All these plans, of course, dealt with the future and as yet had had little effect on the actual strength of the Air Corps. At the end of March 1941 the GHQ Air Force, which incorporated the striking power of the Air Corps, had 543 combat aircraft, of which only 38 were considered first-line airplanes suitable for combat.[27] Total aircraft strength of the Army was 4,975 planes, over half of them trainers. Of the 1,617 combat types (many in overseas departments—Panama, Hawaii, and the Philippines), the great majority were obsolescent.[28] Under the 5,500-plane program adopted in 1939, the Air Corps was supposed to have by June 1941 a total of 1,900 first-line planes. The failure to achieve this goal has more than one explanation. First of all, aircraft production had not been accelerated at the anticipated rate.* Of actual production, moreover, the British had enjoyed high priority on acceptances of late-model planes. The Air Corps also had agreed to defer delivery of many of the planes originally scheduled under the program in order to get later models which were still under development. Yet another factor affecting the delay was the priority necessarily given to the construction of training aircraft over combat planes.[29] As General Marshall explained late in 1940, the real need was for the "productive capacity to maintain our organization on a war basis," and "actual production of the planes prior to our becoming involved in hostilities would result in deliveries far beyond our necessities, with the inevitable accumulations of obsolete types."[30]

It should be observed, too, that the practice of fixing objectives in terms of a specified number of planes tended to establish a misleading

* The Anglo-American agreement of 23 July 1940 had settled on a tentative U.S. production objective of 12,899 military aircraft between 30 June 1940 and 1 April 1941. Actual production for the nine-month period was 6,933.

standard. There can be a vast difference between one plane and another, and the over-all number of planes possessed by an air force can provide no more than the roughest index to true strength. During 1941 a new emphasis on the production of heavy bombers introduced another factor affecting the rate of progress toward announced goals. Winston Churchill had been among those whose influence helped persuade Roosevelt to accept the 3,600-bomber program in the fall of 1940, and the persuasion of the British, who planned to strike back at Germany with a strategic air offensive, was partly responsible for a directive to Stimson on 4 May 1941 which called for an increase in heavy bomber production to the monthly rate of 500 planes.[31] As these planes—mostly B-17's and B-24's—took a larger share of the productive effort, pounds of airframe weight rather than the number of planes manufactured offered a more accurate measurement of progress on production. Because the larger planes required more time for construction, their increasing importance tended to extend the length of time required for the achievement of Air Corps programs.

The extension of aid to the U.S.S.R. in the summer of 1941 on a priority basis momentarily higher even than that accorded the British made it still more difficult for the Air Corps to make firm plans for its own expansion. Marshall and Arnold, though alert to the advantages in providing all possible assistance to Great Britain and Russia, could not but experience some exasperation as they struggled to make the U.S. Army ready for all eventualities. By no means least exasperating was the repeated necessity to recompute requirements in what General Echols described as the "mass production of programs."[32]

Organizational Adjustments

Up to May 1940 the military services had continued to follow conventional methods of procurement. For the Air Corps the Materiel Division at Wright Field carried the major responsibility, depending chiefly upon its three (Eastern, Central, and Western) procurement districts. Before December 1939 these districts functioned through a dual organization: one for procurement planning and the other for supervision of contracts let. In that month the two functions had been consolidated in a single organizational structure. Contracts usually were written at Wright Field until October 1939, when the chief of the Materiel Division was moved to Washington.[33] Within the War Department the Chief of the Air Corps was responsible to the

Assistant Secretary of War in all matters related to procurement and production. By law, the assistant secretary was charged with approval of all contracts over a specified amount, usually $500,000 during the early years of expansion and $5 million after 1941.[34]

The Army-Navy Munitions Board, established in 1922 and composed of representatives of the two services, served chiefly to standardize Army and Navy supply items but was also charged to stockpile strategic raw materials. After the President placed the board under his own direction on 5 July 1939, its authority and prestige increased substantially.[35] For a period in 1939–40 the Secretary of the Treasury, Henry L. Morgenthau, Jr., also played a prominent part in the aircraft production picture. Partly because of the Treasury Department's traditional role as a major government procurement agency, partly because of its control of export licenses, and partly because of the secretary's enthusiasm for aiding the rearmament of the western European democracies, the President conferred on Morgenthau broad powers for coordination of foreign purchases, chiefly aircraft, in the United States. For a few weeks in May and June 1940, the Secretary of the Treasury had power to review all supply contracts for aircraft and engines. After June 1940, when the mobilization of industry began in earnest, the secretary's role in the organization and administration of aircraft production diminished rapidly, although he continued for some time to exercise influence over the allocation and export of planes to foreign countries.[36]

By May 1940 it had become evident that the President's greatly expanded program of defensive preparations would require a mobilization of the nation's industrial resources comparable to that of 1917 and 1918. Although aircraft programs held the headlines, plans called also for a substantial strengthening of ground and naval forces. Not only would there be competition between the several military interests, but between military and civilian requirements as well. The NDAC was the first of a series of civilian agencies which undertook to organize and administer the munitions production of the country. By agreement with NDAC (later, Office of Production Management and finally War Production Board), the military services retained control of their own procurement machinery throughout the war, purchasing the materiel they needed and supervising production. NDAC and its successors devoted themselves to providing the raw materials, machine tools, and facilities needed to produce weapons and

equipment for the armed services. The civilian agency also participated in the division of productive capacity between military and civilian requirements and eventually scheduled and controlled the flow of materials and tools into production. In general, it provided the foundation for the procurement and production machinery of the military departments and, especially in the field of aircraft production, attained a high degree of coordination of effort.[37]

But any and all efforts to organize production would have been ineffective without some machinery to integrate the requirements of the various claimants on output. The first step toward eliminating confusion and wasteful competition was the appointment by the Army and Navy in May 1940 of a Joint Air Advisory Committee to advise the service chiefs on employment, requirements, and cooperation of the two air arms.[38] This in itself might have been enough had the American services enjoyed a monopoly of U.S. aircraft production, but that was far from being the case. The agreement reached with the British Purchasing Commission on 23 July 1940, like all other programs at the time, could be regarded as no more than a temporarily helpful guide to policy. Demands on production fixed by a highly fluid world situation made it clear that problems of allocation required a continuing study and review. Accordingly, the Air Corps urged in July, and again in August, that an Anglo-American agency be established for the better control of allocations. On 13 September 1940, with the concurrence of the Navy and the British Purchasing Commission, Secretary of War Stimson appointed a committee to "consider and decide matters pertaining to aircraft standardization and aircraft delivery schedules."[39] Originally known as the Army-Navy-British Purchasing Commission Joint Committee, it became the Joint Aircraft Committee (JAC) in March 1941 and evolved into the top authority for the approval and coordination of all aircraft contracts for military purchasers—both foreign and domestic. It included two members each from the Army, Navy, British Purchasing Commission, and OPM. It had "power to schedule the delivery of, and allocate the capacity for, aircraft and aircraft components in the official program for all customers, Army, Navy, British, and other Foreign and Commercial." It had also the final say in standardization of aircraft and aircraft components.[40] Like other combined British and American committees, JAC worked chiefly through subcommittees, the JAC itself assembling as occasion required for the determination of policy.

The Chief of the Air Corps acted as chairman, and the Air Corps, as the principal interested party, tended in other ways to assume the leadership.

The pre-Pearl Harbor organization for production was completed by establishment of the Aircraft Scheduling Unit at Wright Field. This agency, which eventually employed more than 3,000 people, determined the requirements of materials, components, and parts for the various aircraft programs; arranged with OPM (later WPB) for the provision of these materials; and allocated, in accordance with established priorities, the available materials among the various aircraft programs. The need for such an agency had become increasingly urgent, for aircraft production could get nowhere without efficient and orderly allocation of necessary materials and components. The Aircraft Section of OPM proposed in February 1941 that a scheduling unit be established at Wright Field, where the Materiel Division of the Air Corps was already performing certain portions of this function. Using Air Corps personnel as a nucleus, OPM established the Aircraft Scheduling Unit at Dayton, Ohio, on 5 May 1941 as an agency of its Aircraft Section. In order to give the unit a broad foundation, it included Army, Navy, OPM, and British representatives. The Navy, in particular, had insisted that the unit be placed under OPM rather than under the Air Corps, feeling that the interests of the Navy and the British would be better protected under the direction of a disinterested agency. The Aircraft Scheduling Unit integrated its activities with those of the Aircraft Section of OPM, operating under policies directed by the JAC. In practice it depended for production information on the Materiel Division, which had a going organization in its Production Survey Branch.[41] Through most of its existence the unit was dominated by Air Corps personnel.

The Victory Program

By the summer of 1941 widespread sentiment existed among the interested agencies in favor of some attempt to draft an over-all plan of production for the total defense effort. As early as April 1941 members of the General Staff had begun to call for such a plan, and on 18 April Patterson recommended to Stimson that a committee be appointed to work out the production program necessary to achieve victory in the event of war.[42] The Chief of Staff favored the move and in May directed that the General Staff prepare over-all strategic

and supply estimates to govern the Army's expansion. The Secretary of War followed this up by communicating to the Navy, the U.S. Maritime Commission, the Office of Production Management, and the British Supply Council his desire for a joint production estimate.[43]

Meanwhile, Knudsen and John D. Biggers, of the Office of Production Management, had been urging similar action as early as February 1941. OPM was finding it extremely difficult to plan and schedule production without some over-all guide to requirements. The separate programs in existence were shifting, changing, and overlapping to an extent which threatened to reduce planning and scheduling to a state of complete confusion. On 18 June the OPM Production Planning Board emphasized that until an "over-all program for an all-out effort" had been determined, "a basis will not exist for production planning in which the distribution of energy, effort, materials, and facilities will be most effectively directed toward the national objective."[44] The necessary spur to the desired action came in a Presidential directive to the two service secretaries on 9 July—to explore "at once the overall production requirements required to defeat our potential enemies," with the purpose of establishing a munitions objective which the OPM could translate into "practical realities of production facilities."[45] Before the War and Navy Departments had completed their estimates, the President had enlarged the scope of the program to include aid to Russia. On 30 August he asked that the military departments submit to him by 10 September their recommendations for "distribution of expected United States production of munitions of war as between the United States, Great Britain, Russia and the other countries to be aided . . . from the present time until June 30, [1942]." He reiterated his request for an over-all munitions program.[46]

The Joint Board Estimate of United States Over-all Production Requirements was completed on 11 September 1941 and forwarded to the President. It actually represented a minimum of Army-Navy coordination, for the Navy had not seen fit to coordinate its estimates with those of the Army until 5 September. Accordingly the estimate was essentially a statement of three sets of requirements—Navy, Ground, and Air.[47]

The General Staff had called on the Air Staff to prepare the section dealing with air force requirements—a task accepted with relish by Arnold and his assistants. The resulting study, included as an annex

to the Joint Board report, was prepared by the Air War Plans Division in a single week, 4–11 August, and came to be known within the AAF as AWPD/1. First of the master blueprints drawn by the Air Staff, it proved to be an unusually accurate forecast of over-all requirements as well as of air strategy. AWPD/1 was drafted on the assumption that the United States might have to fight Germany and Japan simultaneously, that the defeat of Germany would be given first priority, and that the major contribution of the AAF to the attainment of this end would be made through a strategic bombing offensive.* For this offensive, for the AAF's contribution to the maintenance of a strategic defensive against Japan, for support of ground operations, and for the air security of the United States and the western hemisphere, the AAF would require ultimately a force of 239 combat groups and 108 separate squadrons, an aircraft strength of 63,467 planes (including those for training and reserve purposes), and 2,164,916 men. The monthly replacement rate would be 2,133 aircraft. With prompt steps to initiate an all-out effort, it was predicted that "the air offensive against Germany can reach full power in April 1944."[48] And this proved to be just about right, as did the predictions of total requirements. At its peak strength in 1944–45, the AAF had almost 2.4 million men and women, 243 combat groups, and nearly 80,000 aircraft.

The Joint Board report on American requirements was followed by the preparation of an Anglo-American consolidated statement which Stimson submitted to Roosevelt on 23 September 1941. This statement showed stocks of major items of war materials as of 30 June 1941 and anticipated quarterly production to the end of 1942 for the United States, Canada, and the United Kingdom. British-Canadian aircraft production currently was running ahead of American production, but it was expected that the United States would be ahead by 50 per cent in the last quarter of 1942.[49]

All this represented an effort to provide such long-range prediction of requirements as would permit an intelligent coordination of current programs and their upward revisal as developments permitted in accordance with some over-all estimate of ultimate objectives. At the time, the AAF was still working toward the goal set the preceding March: a force of 7,600 first-line aircraft with 84 groups and 600,000 men. On 7 December 1941, when the Japanese attacked Pearl Harbor,

* See Vol. I, 121–32, 146–47, and Index.

this was still the AAF's approved program.[50] Its staff meantime had been preparing procurement programs designed to fulfill the requirements stipulated in AWPD/1, and had won the tentative approval of the Chief of Staff for plans to procure 30,000 planes in addition to those already on order, which numbered approximately 36,500. The attack at Pearl Harbor, bringing the reality of war on two remotely situated fronts, prompted Lovett to ask on 12 December for an upward revisal in this latest proposal of the number of heavy bombers to be procured.[51] Instead of the 775 bombers per month that had been proposed, Lovett suggested a rate of 1,000 per month with the overall figure to be raised from 30,000 to approximately 33,000. To contain Japan in the Pacific and to carry the war to Germany, it would be necessary to depend upon long-range planes in large numbers. Three days later the Air Staff completed its own revised estimate of requirements, which were presented in AWPD/4. With their faith in the air weapon reenforced by the extraordinarily successful Japanese attacks upon U.S. and British fleet units, AAF planners called now for an air force of 2,922,637 men and 87,937 aircraft and for a "NATIONAL FIRST PRIORITY" for "the production of military aircraft and related equipment."[52]

Although this extreme priority was not to be accorded the aircraft program, the airmen had no ground for complaint of neglect as the President promptly pressed for goals going even beyond those set by the AAF. Early in January 1942 the Air Staff computed its victory requirements for planes, in addition to those already under procurement, to be 32,373 combat planes and 22,443 training and miscellaneous planes, or a total of 54,816 of all types. The planners calculated that in order to meet this requirement, and the demands of the Navy and of lend-lease, it would be necessary for the country to reach by 30 June 1944 an annual productive capacity of 50,000 airplanes, of which 37,500 would belong to the AAF. Simultaneously, Donald Nelson, executive director of the Supply Priorities and Allocations Board,* prepared a program which recommended production of 50,000 completely equipped planes in 1942 and an annual production rate of 80,000 planes by the end of that year.[53] This, no doubt, reflected the influence of the President, who notified Stimson on 3

* This board, established in August 1941 to make policy for and coordinate the whole defense program, had the OPM and other government agencies under its authority. It went out of existence when the WPB was established on 16 January 1942.

January that the "concept of our industrial capacity must be completely overhauled under the impulse of the peril to our nation." More thoroughly alive and sympathetic to the needs of our Allies than any of his advisers except possibly Hopkins, he stressed that "we must not only provide munitions for our own fighting forces but vast quantities to be used against the enemy in every appropriate theater of war, wherever that may be."[54]

The President's letter directed the production of combat aircraft as follows:

Type	*1942*	*1943*	*Target Monthly Capacity*
Long-range, heavy, and medium bombers	11,300	30,000	3,000
Light, dive, torpedo, and scout bombers	11,000	17,000	2,000
Pursuits	16,000	38,000	3,500
Observation and transports	6,700	15,000	1,500
TOTALS	45,000	100,000	10,000

These figures, which were increased by the necessary addition of non-combat types, ran far in excess of any goal that had ever been given serious consideration, and they reflected an assessment of foreign-aid needs much greater than the Army and Navy had assumed. The President recognized that many changes of detail would be required, but the "substance of this program [was] to be initiated at once in all its implications."[55] Three days later, in a message of 6 January, he reported to Congress that he had ordered the production of 60,000 planes (45,000 combat) in 1942 and 125,000 (100,000 combat) in 1943.[56]

Immediately before the President's message, the War Department had raised production goals to 45,000 planes for 1942, of which approximately 28,000 were to be combat types, and to 65,000 planes for 1943, of which 45,000 would be combat types.[57] At a meeting on 8 January, representatives of the military and civilian agencies concerned with production agreed that a "supreme effort" must be made to accomplish the objectives set by the President but that it was "highly improbable that such an objective could be met in toto."[58] The conferees decided to go ahead with earlier programs for which estimates had already been put in the hands of the Bureau of the Budget in order to guarantee uninterrupted production and expansion of facilities.[59] The 84-group program, the most recently approved combat-group program for the AAF, was superseded on 7 January

by a 115-group program carrying provision for a personnel strength of 998,000. This became a new "first aviation strength" of the AAF and was to be completed by 31 December 1942.[60]

An agreement between the Army and Navy on the distribution of combat aircraft for 1942 and 1943 gave the Army 34,830 and the Navy 10,170 planes from anticipated production during the first of these years, and 78,210 and 21,790 respectively in the second year. As indications of AAF plane strength, however, these figures can be misleading, for they included aircraft destined for transfer to our Allies, aircraft mainly of Army types. The agreement got the President's approval on 14 January 1942,[61] and Congress acted quickly to provide the funds needed. For the 33,000-plane program requested by the War Department in December, a program initiated before the President had so drastically revised the ultimate goals, Congress on 30 January appropriated $12,525,827,474, the largest single amount ever provided for the equipment of the military forces, and all of it was for the AAF. The sum appropriated for complete airplanes alone, $7,-144,056,340, was greater than the Air Corps had received for all purposes during its entire existence. Further appropriation measures in April and July covered the purchase of an additional 54,620 planes by the AAF through fiscal 1943. By mid-summer Congress had provided almost $30 billion for the AAF, the greater part of which would be spent for the purchase of 87,620 aircraft.[62]

There would be money enough—no one worried about that now—but whether the planes could be produced was another and still critical question. Early in July 1942 it seemed that production capabilities would permit organization of 122 groups by the end of that year and 283 by the end of 1943,[63] a substantial number of which could not be ready for operation until later dates. The President in May had reiterated his intention to attain the objectives set by him in January,[64] but production leaders came to believe more and more strongly that these goals, particularly those for 1943, could not be met. In August, Donald Nelson of WPB, with the concurrence of the War and Navy Departments, notified the President that aircraft objectives could not be met for either year under existing conditions and that production in 1942 probably would not exceed 48,000 planes. For the next year 92,000 planes was the best estimate. Only a preference for the aircraft program greater even than that it already enjoyed could solve the problem; such a "green light" might raise the total in 1942 above

50,000 planes and in 1943 to 107,000. Nelson urged that the "aircraft program as a whole be preferred over all other production" and that great care be exercised in giving highest priorities to other projects.[65]

On the same day, 24 August, the President asked the AAF to prepare a new study of the requirements for combat aircraft production in 1943 to attain "complete air supremacy over the enemy." The study was to be made "without consideration of existing schedules or production possibilities or any other competing military requirements." As a check against this theoretical study, he asked that General Marshall and Admiral King submit a second schedule based on "realities and the proper relationship of air power to the Navy and our ground forces."[66]

The request came at a critical point in the fortunes of the AAF. Although congressional appropriations had placed at its command resources far in excess of anything hitherto dreamed of, and although the large share of the nation's total productive capacity already committed to the aircraft program guaranteed a major role for the AAF in the prosecution of the war, it was not yet certain that the AAF would be allowed to fulfill its most cherished hope—the mounting of a full-fledged strategic air offensive against Germany. Indeed, the recent decision to invade northwest Africa during the fall of 1942 in preference to an early invasion of western Europe had called into question the whole plan of AAF leaders for a strategic attack on Germany. Not only would the planes scheduled to begin the bomber offensive from England be required for support of TORCH and its subsequent developments in the Mediterranean area, but the bomber offensive had no place in strategic plans except as a preliminary air offensive to soften up the enemy in preparation for a landing in western Europe. The cancellation of plans for any such early landing necessarily gave first claim on all available resources to the support of a hazardous venture in Africa—and more than that, it opened the way for the Navy, whose forces had recently invaded Guadalcanal in another hazardous venture, to ask for review of priorities heretofore based on the assumption that western Europe must be invaded at the earliest possible moment.*

* For fuller discussion of these issues and the complicated sparring which resulted from the decision in favor of TORCH, see Vol. II, *passim*. For an excellent recent discussion of over-all strategy, see Maurice Matloff and Edwin M. Snell, *Strategic Planning for Coalition Warfare, 1941–1942* (Washington, 1953).

Previous commitments of productive capacity to long-range bombers offered some assurance, but these commitments involved for the most part production still lying in the future. It would be possible to divert that production to other types of planes and thus, for all practical purposes, to cancel the bomber offensive against Germany. Not until the Casablanca conference of January 1943, at which a directive for a combined Anglo-American offensive was agreed upon, could the AAF feel real assurance on the question nearest its heart.

AWPD/42, submitted by the Air Staff on 9 September, was built around the requirements for a strategic air offensive against Germany. For all purposes, including defense aid, the study recommended production in 1943 of 130,906 airplanes plus 8,248 gliders. The AAF's share of this would be the total glider production and 75,416 airplanes, of which 63,068 would be combat planes. Air operations would require the organization and deployment by 1 January 1944 of 281 groups, 76 of which would be heavy bombardment. The personnel requirement would be 2,734,347 men.[67]

For almost three months thereafter the requirements set forth in AWPD/42 stood at the center of an intensive debate over production capacities and their proper allotment. The AAF made strenuous efforts to have AWPD/42 accepted as the "Bible" for American strategy and aircraft production. General Marshall initially supported the aircraft goals set by the AAF but subsequently concurred with a reduced production figure for 1943. The Navy disagreed flatly with the study's assumptions and especially with its assignment to the AAF of all heavy and medium land-based bombers, a proposal that had been made without consulting the Navy.[68]

While the Navy's strong objections weighed heavily against AWPD/42, another argument was even more effective: a productive capacity not capable of meeting the goal of 131,000 planes in 1943 unless the Navy and ground forces programs were substantially reduced, an unlikely prospect at a moment when both ground and naval forces were just beginning to take the offensive. The Joint Aircraft Planning Committee reported to Nelson at the end of September its sober conclusion that not even the President's January 1942 goal of 125,000 planes in 1943 could be attained except at the cost of 40 per cent of the nation's military production and a consequent reduction of ground and naval programs.[69] On 1 October the President reiterated to the Joint Chiefs of Staff his desire that the

goal remain 100,000 combat planes (plus 25,000 others) to be delivered during 1943. At the same time he directed Nelson to take the steps necessary to insure that production.[70]

In spite of the President's directive and the efforts of Arnold to convince the Joint Chiefs of Staff of the desirability and feasibility of the larger objective, it became clear that neither military nor civilian production staffs were willing to accept such a production figure. According to General Somervell, the Army's chief production officer, the War Production Board was convinced by mid-October that the maximum aircraft production for 1943 could not exceed 107,000 planes, of which 80,500 would be for combat. Somervell notified Marshall on 17 October that studies by the Joint Planning Staff of the JCS indicated that the country could not transport overseas and maintain there by the end of 1943 an air force of the size contemplated in AWPD/42, and the President's goal of 100,000 combat planes in 1943 would provide far more planes than could be logistically supported in combat. The 107,000 planes which the WPB believed could be produced in 1943 would meet all operational needs and fix air strength within limits that could be supported.[71] Two days later Nelson notified the Joint Chiefs that the President's objective could not be achieved in 1943 and that the munitions program would have to be reduced.[72] In spite of Arnold's objections, the JCS promptly confirmed this conclusion and recommended a program of 82,000 combat planes and 25,000 trainers for 1943; the President accepted the schedule on 23 October.[73] On 29 October the President directed that this program for the delivery of 107,000 planes during the next calendar year "be given highest priority and whatever preference is needed to insure its accomplishment."[74]

Thus 107,000, rather than the President's 125,000 or AWPD/42's 131,000, became the number representing the highest possible aircraft production for 1943. To the maintenance of that standard the AAF devoted its full effort in all ensuing negotiations; to the accomplishment of some further reduction in the figure the Navy devoted its energies no less zealously, objecting to an overriding priority for aircraft production and demanding a top priority for significant parts of its shipbuilding program. In what perhaps may be described as a typically Rooseveltian compromise, the President agreed on 26 November to the establishment of a "No. 1 Group" of priorities which, as subsequently formulated by the JCS, quickly

came to include large portions of the munitions programs of the Navy and the ground forces in addition to the aircraft program.[75] The long-enjoyed priority for the aircraft program was a thing of the past, and little likelihood existed that even the goal of 107,000 planes could be met in 1943. Although Nelson notified the JCS on 3 December that he believed that the 107,000-plane program could be completed on schedule, most of its own production experts disagreed with him and proved to be better prophets.[76]

Arnold was realist enough to grasp the hard facts in the new situation. To his key advisers on 22 December he issued this warning: "Outside of this room we want 87,000 planes and that is our position . . . but we must be realistic and I think that 60,000 planes is a fair estimate." Production of 60,000 combat planes in 1943 would still permit the AAF, in his judgment, to carry out the program of 273 combat groups which already had been officially approved by the War Department.[77] On 5 January 1943 Arnold notified his full staff that 273 groups represented the "saturation point for American air power" and directed that they use this figure in preparing subsequent plans and programs.[78] And this remained the framework within which the AAF was built to its ultimate combat strength.

Consistently supporting the highest possible figure on bomber production, the AAF had succeeded in holding for itself a share in the national production large enough to provide some assurance that its ideas would govern final decisions on strategy. No one can say just what shaped Roosevelt's attitude at Casablanca in January 1943 on proposals for an all-out air offensive against Germany, but the full record suggests that he might well have asked himself in what other way the planes in production or on order could better be employed. In any case, it was agreed that a directive should be issued for the Combined Bomber Offensive, which officially got under way in June 1943 and continued to the eve of the Normandy landings on 6 June 1944.*

In truth, the whole discussion of aircraft production in terms of the number of planes to be produced had come by 1943 to be more than a little misleading. The aircraft industry during December 1942 had produced 5,493 aircraft, which represented a production rate of almost 66,000 planes per year. But the more than 40 million pounds of airframe weight produced provided a more exact index

* See Vols. II and III.

to the increased output of the industry, for it represented almost a 50 per cent increase over July 1942, whereas the increase in the number of aircraft was little more than 33⅓ per cent.[79] This increase of airframe weight reflected the growing number of combat planes, as against the smaller trainers, that were being produced and a greater emphasis on heavy bombers. In earlier days the round numbers thrown out by the President had served useful purposes: they had provided a quick and ready yardstick for the measurement of drastic changes in policy, and they may have served to stimulate a hardening resistance to Nazi ambitions as so evidently had been the President's purpose. But what counted now was not the over-all number but the rate of production on particular types of planes. Indeed, the danger existed that a continuing focus of attention on the total number of planes might encourage the production of types having little if any tactical utility.

But the long-established practice of fixing aircraft production policy in set programs for a specified total of planes discouraged any move by the AAF to place the formal discussion of that policy on a more realistic basis. Inside the family, the problem was discussed freely. Thus in February 1943, Maj. Gen. Davenport Johnson, Director of Military Requirements, declared that to the "word 'PRODUCTION' is being attributed an importance not entirely consistent with the military requirements for winning a successful war against our enemies." As a result of the intense pressure for high production, he warned, models of little or no use to the AAF had been continued in production. He specified the A-31* as "a shining example of the waste of material, man-power, and time in the production of an airplane which this office has tried to eliminate for several months." Continued insistence by the AAF on a goal of 107,000 planes for 1943 might have the effect of providing that many aircraft but not necessarily in the types needed to fight the war, an opinion shared also by General Echols.[80] Nevertheless, in March the Chief of Air Staff, Maj. Gen. George E. Stratemeyer, protested against consideration by the JAC of any proposal "to submit to the President, at this time, a suggestion or request that he reduce the 1943 production objective for combat aircraft."[81] And in April Arnold again put his staff on notice that "our program for 1943 is 107,000

* A-31 was the AAF designation for the V-72 dive bomber developed by Vultee Aircraft for sale to the British.

planes. We will not cut down below that figure and we will not discuss . . . a reduction below that figure."[82] As he long since had put staff planning on an altogether different basis, it can only be assumed that Arnold, who by now had a full and varied experience in inter-service diplomacy, feared the effect of any formal concession on a program which had the sanction of a Presidential directive.

Lovett had taken a different view. In a letter of 25 March to Harry Hopkins he recommended that "a realistic production 'figure' should be given the President," who might be well advised to revise downward his aircraft production directive. "By facing the facts frankly at this time," Lovett wrote, "I believe that much good will result and that we will get more planes rather than less by removing doubt and confusion in the Services, industry and the public."[83] Arnold himself had gone so far in March as to notify Marshall of the necessity to postpone the terminal date for the 273-group program from the end of 1943 to June 1944 or later because of delays in production. His request that the goal of 273 groups be retained was approved.[84] The War Production Board stood with Lovett on the need for a downward revision. In March it estimated that 1943 production would be 90,000 planes and that the limit for 1944 should be 120,000 instead of 150,000. Its figures for 1943 were revised several times during the next month or so, and in June Nelson formally notified the JCS that the production goal for 1943 had been lowered to 95,000 planes.[85] But this notice could bring no change in the official figure without the agreement of the JCS, who, interestingly enough, refused to go along.[86]

The explanation for this decision must depend partly on conjecture. JCS minutes provide no more than a clue. The JCS was a committee and Arnold was a full-fledged member; since all JCS decisions had to be unanimous, it was only with Arnold's concurrence that it could act at all. But there seems to be no evidence that he was forced to make a stubborn stand. The record suggests rather that everybody was happy with what they had got out of the negotiations of the preceding fall, and that no one was inclined to reopen the debate. Adjustments in the "must" program during the month of March had given new assurance that naval and ground force needs would be met, and the JCS took the position that high goals provided a spur to production, psychologically comforting to the United States and its Allies and possibly dismaying to its enemies.[87]

That the AAF was doing well enough is indicated by Arnold's concern as early as April 1943 that production would outrun the training program. At that time he observed that "every indication points to our having far more heavy and medium bombers and fighter planes by midsummer than can be manned by our new combat units, employed as replacements in combat theaters, or profitably used by our schools."[88] Combat loss rates had been less than anticipated, making more planes available for equipment of units at an earlier date than had been expected. One solution, a desirable one, was to increase the unit-equipment strength of combat groups and to build up reserves in the theaters.[89] This was eventually done, especially with heavy bombardment groups. The AAF dilemma is made refreshingly clear in a memorandum to Arnold from one of his staff officers on 14 July 1943. He recommended that the JCS send no reply to Nelson's letter concerning the downward revision of the 1943 plane program because "even with the 95,000 program we might have more airplanes that we could use in 1944 under current AAF program and it . . . [is] bad judgment to needle WPB for more planes until we . . . [know] we could use them under revised AAF program now being prepared." Displaying a flair for political as well as military strategy, the officer advised that by "not challenging Mr. Nelson again on this matter, we make it possible for him to say at some later date that JCS have accepted by silence his reduction of production target from 107,000 to 95,000 planes."[90] This advice, quite evidently, was ignored.

By the summer of 1943 assembly lines all over the country were full, and the question of production goals for that year tended to become increasingly unimportant. As attention turned to production during 1944, the adoption of a goal of 120,000 planes was accomplished with much less discussion than had marked the adoption of a program for 1943. The AAF concentrated on efforts to meet its 273-group program, which was reaffirmed as a goal in November 1943 and again in 1944 although consideration had been given in 1943 to the equipment of as many as 350 groups.[91] Congress on 1 July 1943 had provided $23,055,481,000 for the purchase of 99,740 planes plus spares by the AAF through 30 June 1945.[92]

In 1944–45 capacity was progressively shifted to construction of bigger bombers and transports. The most important change affecting over-all quantity production was the decision late in 1943 to maintain

a strategic reserve of initial equipment for ten ground divisions and twenty-seven air groups. This reserve remained a part of the Army supply program until September 1944, when the War Department approved the AAF's recommendation to eliminate it because a strategic reserve was no longer necessary and because ample reserve stocks of aircraft were on hand.[93]

The AAF never attained its goal of 273 groups, although it reached a total of 269¼ groups at the end of 1943. Many of these groups existed only on paper, however, and the true maximum of 243 groups was attained only in March 1945.[94] Well before that date, planning had already shifted to consideration of the contraction of aircraft production and military strength, a subject outside the scope of this chapter.

Scheduling Production

While the President established the over-all production objectives, it required a large and complex machinery to translate those objectives into detailed production schedules for guiding the allocation of facilities, tools, materials, and manpower. Eventually, these schedules also permitted the AAF and the Navy to plan their expansions with some assurance, for the rate of growth depended on aircraft deliveries.

The need to schedule production became imperative only after the United States embarked on a serious rearmament program in the summer of 1940. Up to that time the military services had exerted no great pressure for expansion of the aircraft industry or rapid acceleration of its production. The Air Corps had ordered 435 planes during fiscal year 1939 and 1,677 in fiscal 1940, the latter number in connection with the 5,500-plane program. The Navy's orders had been even smaller. But the heavy orders placed by the French and British in 1939–40 far exceeded those of the American military services and required an expansion of facilities which was financed by the two countries. Under the shadow of the Luftwaffe, England and France were willing to pay premium prices for American planes and to provide the funds for an acceleration of production. American manufacturers gave priority to foreign orders initially because of the larger profits to be made and later because the American government deemed the needs of England and other countries to be greater than our own and deferred deliveries to the Army and Navy. Ac-

cordingly, the Air Corps received very few planes from the manufacturers during 1939-40.[95]

After May 1940, American and British demands on the industry for a huge number of planes in the shortest possible time changed the production picture drastically. Competition among the British, the Navy, and the Air Corps led to competition among the aircraft manufacturers for the limited resources available and threatened to create a near-chaotic condition in the industry. The production effort required to meet the President's goals would affect virtually every part of American industry. Under such circumstances, the need for coordination and control of aircraft production became acute. The NDAC in June 1940 began to provide a measure of coordination, especially in aircraft production.

A number of preliminary steps preceded the issuance of the first aircraft production schedule in late August 1940. The Aircraft Section of the NDAC, organized in June 1940, was fortunate in attracting a group of competent and experienced men. Theodore P. Wright, Dr. Albert E. Lombard, Jr., Robert E. Lees, and Myron A. Tracy established a basis for the eventual formulation of detailed production schedules by preparing a number of reports on aircraft procurement, manufacturing capacity, and prices. But it was not until after the Anglo-American agreement of 23 July 1940 that the Aircraft Section had the necessary data from which to prepare a production schedule. This first schedule, Report No. 8 of the Aircraft Section, was issued on 22 August and listed by type, model, and manufacturer the monthly schedules for airplanes, including spares, for the Air Corps, the Navy, and the British. Report No. 9, issued on 9 September, dealt with engines, and Report No. 10, on 6 November, with propellers.*[96]

Between August 1940 and March 1943 the Aircraft Section issued twelve revisions of the 8, 9, and 10 series, running from A through L. Through No. 8-H, the reports were usually approximations above the manufacturers' estimates of their production capabilities. These estimates were consistently high, and actual production ran well behind plan. Until the coming of the war the schedules, which forecast production by eighteen to thirty months, were revised every

* Engine and propeller deliveries were scheduled sixty days ahead of airplane deliveries in order to provide a smooth flow of all the aircraft components needed for final assembly.

few months, whenever some important change in requirements or capacity seemed to warrant it.[97] The schedules during 1940–41 reflected the changes both of quantities and of types and models needed, with the latter frequently causing as much adjustment as did the constant increases in quantity. Because they were production guides, the schedules had to take immediate cognizance of changes desired by the Army, Navy, and British. Report No. 8 lasted less than three weeks, being superseded on 9 September 1940 by 8-A, which called for the delivery of 47,495 planes, including spares, between August 1940 and July 1942. Report No. 9, issued simultaneously, showed a requirement for 86,198 engines of all types over the same period.

Schedule 8-B, issued on 23 October, revised total deliveries downward to 41,341 planes, in order to bring objectives closer in line with possibilities. But under the pressure of further demands from the British and from the Army and Navy, the aircraft program was still further expanded and production had to be rescheduled. By February 1941 the major outlines of the expanded programs had become clearer, and the Aircraft Section issued Report No. 8-C, which, including B-29 and B-32 production models, projected production through fiscal year 1943. Of the 78,961 planes scheduled, the Army would receive 43,780; engine requirements were raised to 226,301. The three succeeding schedules, issued between April and July 1941, made comparatively minor changes. The last of the pre-Pearl Harbor schedules, 8-G, appeared in October and reduced to 75,637 the number of planes planned through fiscal 1943.[98]

The first major departure from routine scheduling came in January 1942 as a result of the President's directive for production of 60,000 planes in 1942 and 125,000 planes in 1943. Although many responsible production people felt that these goals could not be met, the military insisted that the President's statement be accepted as a military order, and production schedules were prepared accordingly. The outcome was the institution of schedules with initial and ultimate objectives, beginning with 8-I at the end of January 1942 and continuing through 8-J and 8-K. The initial objective, based on the current program and contracts, was both the realistic working schedule assigned to manufacturers and the basis for planning immediate plant expansion and allocation of materials and equipment. The ultimate objective, designed to meet the President's goals, called for

an acceleration of production far beyond that in the more practicable initial objective. The difference in numbers between the two objectives was especially great for 1943. For 1942, Schedule 8-I had an initial objective of 51,061 planes and an ultimate objective of 68,166. For 1943 the goals were 88,366 and 131,417 respectively. In the two succeeding schedules, 8-J and 8-K, the gap between the two objectives narrowed substantially, largely because they were issued later in the year and included the actual production figures for the earlier months of 1942. With the passage of time also the rate of production acceleration became more discernible and permitted changes more in keeping with probability. Objectives were as follows:[99]

	1942	*1943*
8-J Initial	53,504	97,337
Ultimate	64,465	129,017
8-K Initial	52,671	107,111
Ultimate	61,665	129,973

The additional aircraft production scheduled in the ultimate objective was never actually assigned to specific plants, although expansion of facilities and production of materials and equipment were scheduled on such a basis. It has been pointed out that it was a mistake to give the ultimate program official status because, by gearing facilities expansion and output of materials and equipment to it, resources were dissipated. Since the production scheduled under the ultimate objective was never attained, there were bound to be materials and parts surpluses which caused difficulties and distortions in achieving the initial objective.[100]

By the end of 1942 the President had revised downward his production objective for 1943, and it became possible, as well as desirable, for the production planners to eliminate the ultimate objective and prepare a single working schedule. Report No. 8-L, issued on 30 November 1942, constituted the working objective and formed the basis for planning immediate plant expansion and allocation of equipment and materials among manufacturers. In March 1943 the Aircraft Resources Control Office (ARCO)* replaced the 8-series of reports with the W-series, and the 9-series of engine reports became the WE-series. These new series of schedules were issued as amendments to 8-K until W-5 was released on 15 July as an over-

* Successor to Aircraft Section. See below, p. 293.

all detailed schedule superseding all preceding ones. After the publication of W-6 and W-7 in August and September, the Joint Aircraft Committee directed that schedules thereafter be issued quarterly; and this was done, beginning with W-8 on 18 October 1943 and continuing through the final W-15 of July 1945. Schedule revisions for individual plants were issued from time to time as was necessary.[101]

Production schedules sought to reconcile the requirements of the claimants—AAF, Navy, British—with the production potential of the aircraft industry. During 1940–42 these schedules were intended primarily to provide guidance for the expansion of industry rather than to set firm goals for airplane deliveries. Accordingly, the estimates of deliveries were high, and it was not until 1943 that the schedules actually became forecasts of future production. By that time the aircraft industry was approaching its peak, claimants realized that they were sure to get most if not all of the planes they required, and the organization and operation of aircraft production had reached a high level of coordination. Apparently, many manufacturers remained skeptical of the constant urgings of the Aircraft Production Board for greater output, feeling that the schedules were arbitrarily established "numbers programs." In July 1943 the board found it necessary to assure the industry that the production schedules represented the realistic requirements of the military services, but it also sought greater accuracy in its scheduling thereafter, reducing schedules when necessary to bring them in line with the actual production trends.[102]

The schedules prepared by the Aircraft Resources Control Office and its predecessors were derived from information submitted by the manufacturers, by the claimant agencies—the AAF and the Navy—and from studies of capacity, of delivery rates, and of materials available. ARCO balanced the schedules submitted by the AAF and the Navy against probable deliveries. The completed schedules were reviewed by the AAF, the Navy, and British representatives. After acceptance by the Joint Aircraft Committee, the Aircraft Production Board had to give the final approval. The working schedules used between 1943 and 1945 were generally based on the manufacturer's estimate of his probable production for a given period of time. On the basis of experience and knowledge of possible changes and special circumstances which might affect production, ARCO frequently

revised these estimates, usually providing for goals which were expected to exceed actual acceptances by a small margin. This was considered necessary in order to make certain that the supply of engines, propellers, and other parts and equipment kept up with airframe production. In 1944, for example, ARCO made more than 200 interim individual model changes in the schedules, which led to further changes in component schedules and materials requirements.[103] The actual details of controlling and allocating within the industry all aeronautical equipment and critical materials were done, under ARCO's direction, by the Aircraft Scheduling Unit* at Dayton. Authorized to use the field inspection agencies of the AAF, the Navy, and the British, the scheduling unit carried out its highly complicated and important task by following JAC preference lists which set up six priority groups among the various aircraft types and models.[104]

A Final Word on Organization

As the preceding discussion repeatedly has suggested, a major part of the production control problem was coordination of British and American programs. At no time during the war did the two countries see fit to attempt a closely integrated combined program of production. But the two Allies did try through the Combined Chiefs of Staff and its subordinate agencies to establish necessary controls over the flow of raw materials and the allocation of munitions. The chief agency serving these purposes was the Munitions Assignments Board, established early in 1942 under the chairmanship of Harry Hopkins,[105] which functioned through a dual organization, one part in Washington and the other in London. In Washington, the AAF held the chairmanship of the Munitions Assignments Committee (Air), a major subcommittee of the board. Acting under directives from the CCS, the MAC (Air) assigned munitions from a common Anglo-American pool, which included American lend-lease production. Each country had first call on its own production, and each retained control of its own facilities and determined its own production program.[106] The Joint Aircraft Committee yielded to the MAC (Air) its control over allocation of aircraft, but in connection with its scheduling of aircraft production it retained control over allocation of aircraft components to the manufacturers. In-

* For a discussion of the scheduling unit, see above, p. 274.

evitably, there remained a considerable area of overlapping jurisdiction which could lead to misunderstanding.[107]

In the War Production Board, which replaced the Office of Production Management during January 1942, the Aircraft Production Division became virtually a separate organization within the WPB. The overriding importance attached to the aircraft program by the President's directives led WPB to establish on 9 December 1942 a special Aircraft Production Board (APB), under the chairmanship of Charles E. Wilson, WPB vice-chairman. The other members of the board were Lt. Gen. William S. Knudsen, then of the office of the Under Secretary of War, one representative each from the AAF and the Navy, and a recorder appointed by the chairman. The recorder was Theodore P. Wright, a former official of Curtiss-Wright and a key figure in the planning and scheduling of aircraft production from 1940 through 1944. The board assumed central direction of aircraft production, including scheduling.[108]

As its executive agency the APB established the Aircraft Resources Control Office, which began functioning before the end of 1942 under the direction of Theodore P. Wright. ARCO acted for the board in all matters pertaining to manpower, materials, and machine tools, and it directed the work of the Aircraft Scheduling Unit. The new agency continued to prepare the over-all production schedules which had been inaugurated by the NDAC in 1940. For the remainder of the war, the Aircraft Production Board, ARCO, and the Aircraft Scheduling Unit constituted the most important aircraft production agencies outside of the military services.[109] The Joint Aircraft Committee, really a combined rather than a joint agency, was dominated by the military.

Within the War Department, the supply task devolved on the Under Secretary of War who, charged by law with responsibility for Army procurement, found it necessary to build up a huge organization during 1940–41 in order to carry out his functions. The procurement of AAF materiel was such an important part of the over-all munitions program that in December 1940 Patterson had appointed Robert A. Lovett as his assistant for all matters pertaining to aircraft procurement and production. After his elevation to the post of Assistant Secretary of War for Air in April 1941, Lovett continued to devote the greater part of his time to supervision of the AAF production program.[110] After the reorganization of the War Depart-

ment in March 1942, the Services of Supply (later ASF) took over most of the procurement functions of the Under Secretary of War, thereby permitting Patterson and his reduced staff to devote their time and energy to making policy, reviewing contracts, and expediting production in general. Because of the special status of aircraft production and the specialized nature of air warfare, the AAF was exempted from the control of the Services of Supply and continued to operate its own procurement and production organization through the Materiel Command.

Inevitably, there were controversies between the AAF and the SOS, for both were headed by aggressive leaders seeking a maximum of responsibility and authority for their organizations. Overlapping functions and conflicting jurisdictions gave rise to differences which often had to be resolved at higher levels. Generally, the AAF came off well on such occasions, and its position and prestige waxed as the war advanced. The whole period from 1940 to 1945 is marked by a continuous trend toward AAF independence in operating its own supply program—from the placing of contracts to the delivery of materiel at forward combat bases.[111]

Throughout the years from 1939 to 1945 AAF procurement and production were carried out by essentially the same men and organization. The Materiel Division, with its top staff at Washington after September 1939, and its operating arm at Wright Field, was the key agency in the performance of this function until March 1942. At that time it was redesignated Materiel Command, with headquarters still in Washington. Wright Field, as the Materiel Center, continued to handle operations. In March 1943, the Materiel Command headquarters was moved to Wright Field and the former headquarters staff in Washington became a staff agency of AAF Headquarters, known as AC/AS, Materiel, Maintenance, and Distribution until July 1944, when it became AC/AS, Materiel and Services. As the representative of the AAF commanding general, the staff agency established policy and supervised operations of the Materiel Command and the Air Service Command, which were combined into the Air Technical Service Command in August 1944, uniting all logistical functions under a single headquarters.[112] This change actually represented a return to 1941, when the Materiel Division had exercised unified control over all aspects of Air Corps logistics.

Maj. Gen. Oliver P. Echols, who replaced General Brett as chief

of the Materiel Division in 1940* remained General Arnold's chief adviser on materiel matters throughout the war, as commanding general of the Materiel Command until March 1943 and then as assistant chief of the air staff at AAF Headquarters. His long experience in Air Corps materiel matters, both as engineer and administrator, made him exceptionally well qualified to render outstanding service to the AAF logistical organization. Lt. Gen. William S. Knudsen, first as Director of Production in the office of the Under Secretary of War from 1942 to 1944, and later as Director of the Air Technical Service Command, contributed greatly to the operation of the whole aircraft production program. Among General Echols' most important assistants in Washington were Maj. Gen. Bennett E. Meyers, Brig. Gens. Edward M. Powers, Benjamin W. Chidlaw, Frederick M. Hopkins, Jr., and Mervin E. Gross, and Cols. Roscoe C. Wilson, John W. Sessums, Jr., and James F. Phillips. Col. William F. Volandt, assistant to the chief of the Materiel Division from 1939 to 1942 and an experienced officer, handled AAF contract administration in Washington until the end of the war, overseeing the expenditure of more than thirty billion dollars. Brig. Gen. Alfred J. Lyon, who died in 1942, performed especially valuable service as technical executive of the Materiel Division between 1939 and 1941.

Echols and his staff provided over-all direction for AAF procurement programs and production, serving as the link between the AAF field organization and Washington, where top policy was being made. Echols himself represented the AAF on the Aircraft Production Board, and he or other members of his organization served on joint Army-Navy committees, in ARCO and the Aircraft Scheduling Unit, with the Joint Aircraft Committee, and on top War Department committees. The relationship between the staff office in Washington and the operating agency at Wright Field was not always clear or harmonious. Even between 1940 and March 1943, when Echols controlled the whole materiel organization, there were serious problems of jurisdiction between Washington and Wright, particularly in dealing with the procurement districts and with aircraft manufacturers. These problems persisted even after the separation of staff and com-

* General Echols actually succeeded Brig. Gen. Carl Spaatz who was chief of the Materiel Division for less than a month after General Brett.

mand in March 1943, but it would have been most unusual if they had not.[113]

Under a series of commanding generals, including George C. Kenney, Arthur W. Vanaman, Charles E. Branshaw, Kenneth B. Wolfe, and William S. Knudsen, Wright Field steadily broadened its functions and responsibilities; each wave of decentralization in Washington washed additional responsibilities into Wright Field. In 1943 Maj. Gen. Charles E. Branshaw, head of Materiel Command, insisted upon further decentralization of responsibilities to the procurement districts. The scope and degree of responsibilities placed on the districts, of which there came to be six during 1943, varied during the war, reflecting the tendencies in Washington and at Wright Field to tighten or slacken the reins of authority. The personnel strength of the Materiel Command from 1939 forward is indicative of the growing importance of the functions it performed. At Wright Field itself the strength grew from less than 2,000 on 1 July 1939 to more than 17,000 in 1943–44. Most of these employees were civilians, but the proportion of military grew significantly during the war, increasing from about 6 per cent in 1941 to about 40 per cent in 1943. The total strength of the command rose to more than 44,000 at the time of its integration into the Air Technical Service Command in August 1944. Of this number, more than 27,000 were in the districts, compared with 6,292 in the districts in January 1942. Civilians constituted more than 70 per cent of the command's total strength throughout the war.[114]

The major procurement and production functions at Wright Field and in the procurement districts were organized under the production, engineering, procurement, and inspection divisions. During the greater part of the period from 1939 to 1945, these divisions operated separately with a considerable overlapping of responsibility and occasional conflicts. The Production Division under the vigorous direction of Brig. Gens. Kenneth B. Wolfe and, later, Orval R. Cook dominated operations at Wright Field until 1944, when all divisions concerned with procurement and inspection were organized into a single agency which handled the whole process from negotiation of contract, through production engineering and inspection, to acceptance of finished articles. Brig. Gen. Aaron E. Jones handled contract administration at Wright Field throughout the war. The procurement districts of the Materiel Command maintained regular

contact with the manufacturers who produced AAF equipment. From offices in New York, Detroit, and Los Angeles, and other such centers, district supervisors directed the operations of a vast network of engineers, auditors, and inspectors who represented the AAF at all of the major plants of the aircraft industry. These resident representatives of the AAF provided guidance and helped solve manufacturers' problems, checked on costs, and inspected and accepted materiel at the plants. Their presence on the premises helped much to keep the machinery of production moving at an accelerating pace. On some matters, particularly contracts, manufacturers sometimes tried to bypass the districts and deal directly with Wright Field or Washington, but the AAF usually frowned on such maneuvers. District supervisors of the caliber of Brig. Gens. Charles E. Branshaw* and Donald F. Stace, and Cols. Don L. Hutchins, Alfred H. Johnson, and Roy M. Jones, were generally capable of handling most of the problems encountered by manufacturers.[115]

The Navy assigned personnel to the Materiel Command procurement districts instead of setting up its own districts and thereby insured a considerable measure of cooperation between the two services. Some idea of the magnitude of the work done by the districts may be gleaned from the sizes of the inspection staffs maintained by the services. In November 1942 there were 110 AAF inspectors and 155 naval inspectors at the Martin plant in Baltimore, 40 AAF and 4 naval inspectors at the Curtiss-Wright plant in Buffalo, and in December 1942, 77 AAF inspectors and 181 naval inspectors with Consolidated and Vultee at San Diego, California.† [116]

The organizational chain which governed aircraft production was completed by the voluntary formation of a production council by the major aircraft manufacturers. In April 1942 the eight largest companies on the west coast formed the West Coast Aircraft War Production Council, and six months later, in October, the eastern manufacturers followed suit. In April 1943 the two branches organized the National Aircraft War Production Council, Inc., for the purpose of coordinating the production efforts of the whole industry. The council served as a research and information agency for the

* General Branshaw was supervisor of the Western District before becoming commanding general of the Materiel Command in 1943.

† The large number of naval inspectors is explained in part by the fact that they performed many duties which the AAF assigned to personnel other than inspectors.

aviation industry, provided a medium for the exchange of production information among manufacturers, and worked with governmental agencies in seeking solutions to industry-wide problems. The pooling of technical knowledge, and sometimes of materials and manpower, as a voluntary action by the industry, complemented the AAF's efforts to bring about a higher degree of coordination within the industry.[117]

Certain special committees organized by the manufacturers made an especially worth-while contribution to production. Perhaps best known among these was the Boeing-Vega-Douglas committee which pooled the efforts of the three companies on behalf of B-17 production.[118] Boeing, the creator of the B-17, could not by itself meet the demand for the plane, and other manufacturers had to be induced to produce B-17's for the AAF. Without proper coordination and sharing of knowledge and resources among the companies involved, the AAF would never have received B-17's, or almost any other major combat type, in the numbers it desired.

CHAPTER 9

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EXPANSION OF AIRCRAFT PRODUCTION

THE success of the American aircraft production program during World War II was to a large extent the result of bold prewar action and a consequent expansion of industrial capacity in 1940 and 1941. The high priority accorded the production of aircraft during those two years made possible the victories over Germany and Japan in 1945—triumphs which certainly would have been delayed had it not been for the overwhelming air supremacy achieved by U.S. armed forces as early as 1944.

Until 1940 the American aircraft industry had continued to operate on a handwork basis. Each plane, though conforming to the standard for other planes of its type and model, had the distinctive qualities of any handcraft product. By 1942 the industry had been converted to mass-production methods, and with government aid in the expansion of plant facilities, the assembly lines stood ready to roll out planes by the thousands and on time schedules that theretofore would have been regarded as impossible. More than that, the automotive industry, leader in the development of mass-production methods, was in process of conversion to the production of aircraft and aircraft parts. Almost 90 per cent of the enormous costs involved in such expansion and conversion were met by the government. The job of providing the necessary productive capacity was virtually complete before the United States had been at war one year.

Foreign Orders

Such mobilization plans as existed in 1938 reflected earlier uncertainties as to the national military objective and suffered from the lack of legislative authority and necessary funds. The critical

production problem had seemed to be that of allocating industrial facilities among the several procurement agencies of the Army, including the Air Corps, and between the Army and the Navy. The Army-Navy Munitions Board served in the latter sphere, while the task of avoiding costly competition among Army agencies fell to the office of the Assistant Secretary of War. Field procurement offices of the several technical services had surveyed some 20,000 of the nation's industrial plants, approximately half of which had been earmarked for conversion to particular types of munitions production in the event of war. But the services had no right to place orders in accordance with these surveys. The Air Corps, for instance, was bound by law to a procedure of competitive bidding in the placing of its contracts, and this allowed no room for the awarding of contracts in accordance with M-day allocations of production facilities. When Congress authorized negotiated contracts in July 1940, previously established allocations already had become for the most part meaningless. Plans had called for detailed production surveys of allocated facilities with a view to determining the monthly production to be expected after M-day, but Congress was slow to provide the funds necessary for such surveys, and the time lag between the fixing of a requirement and the completion of the survey tended to be such as to render the survey out of date by the time it was finished. All M-day plans, moreover, had been geared to estimates of requirements so modest as to have little practical utility for the huge program of aircraft expansion launched in 1939–40.[1]

The most practical and potentially the most fruitful of the measures proposed in the pre-Munich era was the "educational order." Allocations of plants and plant surveys could give no real assurance of the manufacturer's capacity to deliver the materiel as required, for any industry trying to produce an unfamiliar and complicated military item faced very serious problems, especially of tooling, which could lead to costly delay in the attainment of quantity production. Since 1927 the War Department had made persistent efforts to secure approval for a program of educational orders–i.e., for actual production contracts with selected companies for small quantities of items expected to be in critical supply in time of war. Such orders were intended to test a company's ability to produce the item, to give it necessary experience, and to secure production data which otherwise could not be had. But Congress failed to enact the neces-

sary legislation until June 1938, and only in 1939, under the pressure of a deteriorating world situation, did Congress provide liberal funds for the purpose.[2]

Even then, the War Department was reluctant to give the Air Corps any substantial portion of the $34.5 million appropriated for educational orders during fiscal years 1939 through 1941. Although the Air Corps submitted proposed orders and Arnold urged that funds be made available, the industrial planners judged that the Army's technical services, and particularly the Ordnance Department, had the greater need.[3] This probably was true, for the Air Corps, which always had maintained a close working relationship with industry in preference to any substantial dependence on government arsenals, was undoubtedly in better position than were most of its sister arms to plan its expansion on the basis of a practical knowledge of industrial capacities. Moreover, by this time a mounting flood of foreign orders and the newly inaugurated Air Corps program were bringing into use most of the facilities of the aircraft industry. Only in the development of supplementary facilities would the educational order have served a real purpose, and here the aircraft industry, which feared the creation of future competition, opposed Air Corps proposals to place educational orders with automotive firms, and until 1940 the War Department respected the industry's wishes.[4] Prior to that year the Air Corps received no funds for educational orders, and of the $14.5 million ultimately allotted to it, $11 million came only in 1941 for educational orders with Ford, Chrysler, and Hudson in connection with plans for their conversion to heavy bomber production.[5]

By all odds the most important single stimulus to the early expansion of the American aircraft industry was the demand for its products growing out of the desperate attempt by England and France to offset the great superiority of the German Luftwaffe. Indeed, it is perhaps not too much to say that the expansion financed by British and French funds in 1939 and 1940 advanced by as much as a year the time within which American aircraft production would reach its peak.

The Air Corps long had favored export of military aircraft to foreign countries as a means of maintaining and possibly increasing the productive capacity of the American aircraft industry, and during the 1930's, partly in response to pressure from the industry, it pro-

gressively had liberalized its policy of releasing Air Corps production models for export to selected countries, although the latest models were withheld. This policy ran counter to public sentiment against "munitions traffic," and the Anglo-French allies in placing their orders were forced to accept the special hazard imposed by the neutrality legislation of the mid-1930's, which placed an embargo upon the shipment of arms and munitions to belligerents. Nevertheless, between the spring of 1938 and September 1939, when Germany attacked Poland, the two countries placed orders in the United States for more than 1,500 planes—most of them training types or obsolescent Air Corps models like the P-36A, B-10B, and P-35.[6]

The invocation of the Neutrality Act at the outbreak of war served to penalize the victims of aggression rather than the aggressor, as Roosevelt had previously warned. Although his earlier efforts to secure repeal of the arms embargo had been unsuccessful, Roosevelt persisted, and after a bitter debate Congress lifted the arms embargo on 4 November 1939, placing munitions sales to belligerents on a "cash and carry" basis. Use of American vessels for delivery of munitions was still barred, but British and French ships could now pick up aircraft and other munitions in American ports. During the last months of 1939 the Anglo-French Purchasing Commission placed additional orders which brought the number of planes undelivered to approximately 2,500. The Air Corps agreed to the release of later-model planes, including the B-18A, the A-20A, and the P-40. In January 1940 the two countries began negotiations for the purchase of 8,200 combat planes and 20,000 engines of the same types and models as they had been purchasing, delivery to be made by September 1941. But the futility of buying obsolescent planes for use against the Luftwaffe soon impressed itself on the French and British, and on 14 March 1940 they asked for permission to negotiate with the aircraft companies for later combat models, expressing a willingness to accept deliveries into 1942.[7]

This request posed a major problem for the Air Corps because it would require deferment of Air Corps deliveries in favor of the RAF and the French Air Force. After a careful analysis, however, Arnold and his staff concluded that the benefits to the United States would outweigh the disadvantages. Although deliveries to the Air Corps undoubtedly would be delayed, the increase in productive capacity and the consequent aid to the acquisition of still later models than those

being released appeared to compensate for the risk. In return for releasing late models for export, the government could require the manufacturers to make extensive improvements in production and development models at no cost or at an adjusted cost to the U.S. government. In addition, the British and French governments had agreed to furnish the Air Corps with combat performance data on the aircraft to be released, data which promised no small advantage. The President approved the new foreign sales policy on 25 March 1940, with the Air Corps agreeing to the release of a large number of its latest models, among them the P-38, B-17, B-24, B-25, and B-26.[8]

The adoption of the new release policy preceded the German invasion of Norway by fifteen days and the invasion of France and the Low Countries by less than two months. During April and May the Anglo-French Purchasing Commission ordered approximately 6,000 combat planes from North American, Curtiss, Lockheed, Boeing, Douglas, Martin, Bell, and Consolidated. After the fall of France in June, the British took over all French orders in the United States. As of 23 July, Great Britain had 8,275 planes and 21,485 engines on order and undelivered. The United States agreed to permit the British to place orders for 6,118 more planes to be delivered by 1 April 1942 and to exercise options for 21,000 additional engines by 31 December 1942.[9] During August and September 1940 the British placed orders for the additional 6,000 planes authorized in July, bringing to more than 14,000 the total of their planned purchases. Engine orders totaled 25,000 with options for 28,000 more. The value of these contracts, about $1.5 billion, represented half of the dollar-volume of all British munitions contracts in the United States at the time.[10]

By the close of 1940 the British were nearing the end of their capacity to pay for munitions in the United States, and because of the Johnson Act of 1934, which forbade credits of any kind to nations that had defaulted on World War I obligations to the United States, there was no way for them to secure the needed credit. But the President at this critical point called upon the United States to become the "arsenal of democracy," with the ultimate result that the Lend-Lease Act of 11 March 1941 authorized the transfer of weapons and equipment to countries whose defense was considered vital to the defense of the United States. Existing British contracts remained in force, and deliveries on them were made into 1944.[11]

All of the larger, and some of the smaller, aircraft companies par-

ticipated in the expansion, which began to assume boom proportions in the spring of 1940. Boeing, Lockheed, Douglas, Martin, Consolidated, North American, and Curtiss—the larger airframe manufacturers—greatly expanded their capacity during this period. Lockheed, an early recipient of large British orders, more than doubled its manufacturing floor space. Smaller firms like Bell, Vultee, Fairchild, and Brewster also added new space. Both Wright Aeronautical and Pratt & Whitney enlarged their engine plants, the latter quadrupling its capacity between May 1938 and May 1940. Hamilton Standard Propellers tripled its capacity between 1938 and 1940.[12] According to the Aeronautical Chamber of Commerce, the industry spent more than $52 million for plant expansion and installations of new equipment between 8 September 1939 and 10 July 1940. Of this amount, more than $34 million went into engine and propeller plants and $13 million into airframe plants, while the remainder was for accessories and instruments plants.[13] The floor space in airframe, engine, and propeller plants increased as follows:[14]

Date	*Airframe*	*Engine*	*Propeller*	*Total*
		(In thousands of square feet)		
1 Jan. 1939	7,479	1,726	250	9,455
1 Jan. 1940	9,606	3,018	492	13,116
1 Jan. 1941	17,943	6,463	1,050	25,456

In February 1941 Secretary Stimson declared that but "for the early British orders, and the French orders which were subsequently taken over by the British, we would have at this time only a small fraction of the existing aircraft plants and productive facilities." Information supplied by the Air Corps indicated that up to 30 June 1940 the French and British had entered into commitments for aircraft plant extension and production acceleration charges totaling $72,153,000. Similar commitments by the British after 30 June 1940 totaled an additional $51,231,000, making a grand total of $123,384,000 down to February 1941. Anglo-French orders had increased the aircraft engine capacity of the country approximately four times over the previous existing capacity—an increase accomplished for the most part in advance of the enlarged U.S. defense program in June 1940. For the seven principal airframe and three engine manufacturers capital investments derived from the same sources had provided 6,294,000 square feet of additional floor area.[15]

The Problem of Plant Expansion

Meantime, the War Department had been shaping policies for a government-sponsored expansion of aircraft production that would dwarf anything theretofore envisioned. The President's move to stimulate aircraft production in the fall of 1938 had prompted close study of the problem both in the Air Corps and at higher echelons. First thought suggested that the immediate need was to create a stand-by capacity for the production of 10,000 planes per year. Discussions between Assistant Secretary of War Louis Johnson and General Arnold included the possibility of building government-owned factories for the purpose.[16] That funds could be provided to underwrite such a policy seemed doubtful, and during 1939 attention tended to focus on three courses of action: expansion of plant by the manufacturers themselves, encouragement of more subcontracting, and conversion of facilities outside the industry, particularly those of the automotive industry. Of the three possibilities, the larger aircraft manufacturers, fearful lest any other solution create new competition for them, preferred the first, and they looked with special disfavor on any proposal for construction of stand-by government factories.[17]

When after the beginning of the war in Europe the Air Corps raised its estimates of required wartime production to 40,000 planes per year, this goal was 25,000 above the estimated potential capacity of the existing industrial plant.* In order to meet the deficit, Arnold recommended construction by the government of 20 factories, at an estimated cost of $7 million each, with an annual capacity of 1,200 planes each. To meet requirements for more than 82,000 engines, existing plants would be enlarged, new factories would be built, or part of the automobile industry would be converted to manufacture of aircraft engines. He suggested specific locations for the new plants and advised that corresponding increases in productive capacity for a host of additional items would be required.[18] But, for the most part, these proposals were not put into effect. Such expansion of productive capacity as took place was underwritten by private capital on the prospect of continuing foreign and U.S. orders. In this expansion the

* Since most aircraft plants were operating on little more than a one-shift basis, it is obvious that their potential capacity with existing plant was considerably greater than their actual production of less than 4,000 civilian and military planes in 1938. But since military planes are usually much heavier than civilian planes, it is likely that the estimated capacity of 15,000 military planes was overoptimistic.

Air Corps lent its encouragement especially to the development of an additional capacity for the production of engines, already a critical problem for the Air Corps.[19]

Even before the President's call in May 1940 for 50,000 planes, the Air Corps had begun to think in terms of an annual productive capacity reaching that total.[20] On 20 May, four days after the President's historic demand, General Brett urged some 125 representatives of the aircraft industry meeting in Washington to speed up their current deliveries pending adoption of specific government programs. He posed for them the alternatives of government or private construction of additional facilities and emphasized the critical importance of the engine industry, which threatened to provide the chief bottleneck. A day later, Brett recommended to the Secretary of the Treasury that the government build new engine plants to be operated by the more important engine manufacturers. Strangely enough, even in early June, when the outlines of the long-range programs were already beginning to emerge, Brett believed that the airframe companies should not expand their plants until they were all working at their maximum existing capacity. But as the pressure for accelerated production mounted during June, it became clear that airframe as well as engine capacity would have to be greatly increased.[21] The armed services and the NDAC quickly agreed that the government would have to build much of the additional plant but that every encouragement should be given to the augmentation of privately owned facilities and that government-owned plants should be privately operated.[22]

But agreement with industry on the terms for its expansion proved to be unexpectedly difficult. Under the provisions of the Vinson-Trammell Act of 1934 as amended in 1939, profits were to be limited on government contracts for aircraft to 12 per cent of cost, and for naval vessels to 10 per cent, limitations which also applied to subcontractors. The initial expansion of aircraft production had taken place under the provisions of this act, but when Congress, on 28 June 1940, lowered the limit on aircraft contracts from 12 to 8 per cent, the manufacturers promptly refused to sign the proffered contracts. Arguing that prospective rises in the cost of labor and materials made it impossible to estimate costs accurately, the leaders of the industry also emphasized the many other uncertainties which must attend the transition to mass production of new types and models.[23] It was still a young industry with a relatively small capital base and no real expe-

rience with large-scale production. After years of hand-to-mouth existence in which only the strongest had managed to survive, the industry demanded additional guarantees against the risks it was called upon to assume. The manufacturers were especially emphatic in their insistence upon relief by tax amortization of the proposed new construction. Under existing law, they maintained, it would take them sixteen to twenty years to amortize the cost of proposed construction against taxes. If the emergency lasted only a short time (and it must be remembered that the country was not yet at war), they would be left with surplus facilities built at great cost. They asked, accordingly, for legislation permitting the amortization of new facilities against taxes over a period of five years or the duration of the emergency, which might be less than five years. This would permit them to write off the cost of the new plant facilities at a rate of at least 20 per cent per year instead of 5 per cent. The President and the military services agreed that the proposal was reasonable and urged Congress to act.[24]

During the summer of 1940, while Congress debated the subjects of profit limitation and tax amortization, aircraft procurement came virtually to a complete halt. In August, seven weeks after Congress had appropriated $400 million for the purchase of 4,000 planes, the War Department had succeeded in signing contracts for only 33 planes, although General Brett and Colonel Volandt had been ready to negotiate the contracts as early as 15 June. By 20 August contracts for only 343 combat aircraft had been let in the preceding 100 days. It looked to many people as if the aircraft industry were on strike against the government, placing its profits ahead of patriotism and retarding industrial expansion and production to a dangerous extent. But the military services and the NDAC to a considerable extent sympathized with the manufacturers' difficult position. Consequently, the administration played an important part in persuading Congress to substitute a tax on excess profits for a fixed limitation of profits and to permit tax amortization of emergency facilities over a period of five years. The desired legislation was passed early in October, but some manufacturers, loaded down with lucrative British orders, were still not anxious for government contracts.[25]

Although contracts for aircraft and for the expansion of facilities had been delayed through the whole summer, negotiations with industry continued. At the end of July the major manufacturers agreed to begin expanding facilities to meet the requirements of the Air

Corps' 18,000-plane program. Without exception they preferred enlarging existing plants to building new ones, but the War Department and the NDAC believed that it would also be necessary to construct new plants in the interior of the country. In order to get the expansion under way pending the signing of contracts, the Assistant Secretary of War on 15 August authorized purchases by the manufacturers of the jigs, dies, tools, fixtures, materials, and other equipment which would be needed for production—items adding up to costs greater than that for the new plant construction itself.[26]

The War Department and the NDAC had hoped that private capital might finance much of the new construction, but as the increasing scope of the expansion became apparent, the hope was quickly dispelled. Many companies and banks were unwilling to take even the limited risks which remained after the enactment into law of the new tax-amortization plan. Accordingly, the government devised several methods for financing or guaranteeing the financing of new construction. Where the manufacturer desired to own the plant outright, he could borrow the necessary funds from the Reconstruction Finance Corporation. A second procedure permitted the manufacturer to borrow either from banks or the Defense Plant Corporation, a subsidiary of the RFC, under the terms of an emergency-plants-facility contract which guaranteed that the government would pay the full cost of the facility in not more than five annual installments; when payment had been completed, the government would assume title to the property unless the manufacturer desired to purchase it. More commonly, the government simply built the plant at its own cost, usually acting through the Defense Plant Corporation, and then leased it to a private concern for operation. The property reverted to government control at the end of the lease, unless other disposition was directed. By February 1941 federal financing of new plant facilities had reached a figure almost ten times the sum invested by private agencies.[27]

The initial goal in this expansion of plant facilities was the creation of a capacity for production of 35,000 to 40,000 planes per year by 1942; the ultimate goal was a capacity of 50,000 planes to be reached at a yet undetermined date. In the summer of 1940 the industry's maximum existing capacity was 15,000 planes per year. William S. Knudsen of the NDAC, assisted by Dr. George J. Mead and Theodore P. Wright of its Aeronautical Section, played an especially important part in putting the expansion program into effect. Under

Secretary of War Robert P. Patterson acted as the key War Department official, as he did in so many other areas of the munitions program. The Air Corps officers in Washington and at Wright Field most immediately concerned were General Echols, Brig. Gen. Kenneth B. Wolfe, Brig. Gen. Frederick M. Hopkins, Jr., Col. Philip Schneeberger, Col. Edwin W. Rawlings, and Col. J. C. Vaughan.[28]

In spite of the concern over engine production as the most likely bottleneck, plans for expansion of airframe capacity matured more rapidly and were put into effect more quickly. These plans provided for expansion of the floor space of the assembly plants by about 200 per cent, some 225 per cent for the larger companies and 60 per cent for the smaller ones. This concentration on the larger companies was logical from a production standpoint, although many observers objected. The seven major airframe manufacturers undertook to increase their floor space from approximately eight million to more than eighteen million square feet at an estimated cost of $83,082,000. Curtiss-Wright initiated the largest expansion—more than three million square feet. In addition to the enlargement of its Buffalo plant, two new factories—at Columbus, Ohio, and at St. Louis—were planned. Consolidated, Boeing, Douglas, Martin, Lockheed, and North American each planned expansions ranging from 700,000 to 2,000,000 square feet. The lesser airframe manufacturers—Bell, Republic, Vultee, Ryan, Fairchild, and Beech—launched smaller programs.[29] Most of the companies produced planes for both services, but since the Air Corps had the larger organization and the greater interest, it took cognizance, by agreement with the Navy, over most of the plants.*

Two companies, Wright and Pratt & Whitney, dominated aircraft engine production. By the end of 1940 both of them had agreed to undertake a large expansion of their facilities, with Wright building a new plant at Lockland, Ohio, near Cincinnati. Even so, there seemed to be no prospect of meeting the full need without using the resources of the automobile industry, and it was for engine manufacture that this industry was first drawn into aircraft production. When the British made their Rolls-Royce Merlin (V-1650) engine available for production in the United States in June 1940, Knudsen made a vigorous effort to persuade the Ford Motor Company to produce it,

* Among the seven major companies, only Consolidated fell to Navy cognizance.

but Henry Ford adamantly refused to accept the condition that he produce partly for the British. Knudsen then turned to the Packard Motor Car Company, which agreed to accept a contract for a large number of the engines. In September NDAC persuaded Ford to build a new plant at Dearborn, Michigan, for manufacture of engines as a licensee of Pratt & Whitney. During the fall the Allison Division of General Motors at its own expense began a large expansion of its Indianapolis plant.[30]

Next after airframes and engines came provision for a greatly expanded production of propellers, landing gear, gun turrets, oleo struts,* and a host of other parts and accessories, all of them necessary to the completed aircraft and most of them produced by separate companies which specialized in the provision of particular items. Some of the companies enjoyed a virtual monopoly in their fields, and like the airframe manufacturers, they preferred enlarging their own plants to subcontracting or licensing other firms to make their products. Hamilton Standard Propellers, for instance, was quite frank in telling an Air Corps representative early in 1940 that it wished to retain its monopoly on hydraulic propellers and therefore was not interested in subcontracting or in having other companies enter the field. Cleveland Pneumatic Tool Company and Bendix Aviation, Limited, made practically all of the oleo struts and held all of the patents. Such companies as Hamilton Standard, Wright Propeller, Sperry Gyroscope, Bendix, Cleveland Pneumatic Tool, and other long-time suppliers to the Air Corps expanded their facilities many times over between 1940 and 1945, but it was still necessary to convert a large number of additional firms to production of the same items. Frequently OPM and the Air Corps had to exert strong pressure to overcome the initial resistance to bringing new suppliers into production. Ford, the Delco Products Division of General Motors, the Hughes Tool Company, the Menasco Manufacturing Company of Burbank, California, and the A. O. Smith Corporation of Milwaukee were added to the suppliers of oleo struts, a particularly crucial item in the early years. Eventually, Emerson Electric of St. Louis, Steel Products Engineering Company of Springfield, Ohio, the Briggs Manufacturing Company of Detroit, and General Electric joined Sperry Gyroscope, the original supplier, in the production of gun turrets.[31]

* Shock absorbers on landing gear.

The Bomber Program

The expansion of aircraft production facilities had barely got under way in the fall of 1940 when the demand for more bombers provoked a second wave of expansion. Anticipating the future need for more heavy bombers, Arnold early in September recommended to Patterson that the government build two plants for bomber and one for fighter production. Shortly after, Knudsen proposed that the government build two bomber plants with a monthly capacity of 60 planes each,* and the President approved the plan on 16 November.[32]

The War Department had decided that new defense plants should be built in the interior of the country at least 200 miles from the borders, and the Air Corps selected Omaha and Tulsa as the sites for the two new plants. But the hard facts of the nation's economic structure made the policy difficult to follow. The greater part of American industry was concentrated along the Atlantic and Pacific coasts or in the Great Lakes region. Manufacturers in general resisted proposals for a transfer of their operations to areas remotely situated from established centers of labor and technical skills, and not without reason. As Knudsen once explained to General Marshall: "We can't move Detroit."[33] The industrialists' reluctance to invest in dispersed plant facilities was at odds with the government's hope that private capital could finance new inland construction; hence, the War Department could carry out its policy only to the extent that the government was willing to put up the money.[34]

The original plan for increased bomber construction called for assembly of 200 medium bombers per month at Omaha and 100 heavy bombers per month at Tulsa. Further study in December 1940 revealed that it would be impossible to reach this level of production in the two plants, even if subcontractors were used on a large scale, as was planned. The solution was to build four plants instead of two and to bring automotive firms increasingly into the picture as manufacturers of subassemblies. At Omaha, Martin would make 100 B-26's per month from parts and assemblies to be built by the Hudson Motor Car Company, the Chrysler Corporation, and the Goodyear Aircraft Corporation, all of which were to expand their facilities. North American Aviation undertook to assemble 100 B-25's per month

* In October 1940 the NDAC estimated that the prospective monthly productive capacity of the industry was 96 heavy bombers and 305 medium bombers as of 1 January 1942 and 102 heavies and 320 mediums as of 1 June 1942.

at Kansas City, using both its own subassemblies and those supplied by the Fisher Body Division of General Motors and other subcontractors. The production of heavy bombers on the scale planned was too large an undertaking for the original producers to handle alone, and the Air Corps decided to form a pool of manufacturers to produce the B-24, its most immediate concern in the fall of 1940. Douglas and Ford were selected to join with Consolidated, the creator of the plane, in producing the 100 B-24's required above the production planned at Consolidated's San Diego home plant. At a gigantic new plant to be built at Willow Run near Ypsilanti, Michigan, Ford would make 100 "knock-down" sets of B-24's per month. Using these and other components, Consolidated was to assemble 50 B-24's per month at a new plant at Fort Worth, and Douglas, though initially reluctant to participate in the pool, would assemble an equal number at the new plant in Tulsa.[35] Contracts for construction by the four new assembly plants were not signed until February and March 1941. The two medium bomber plants were to be built on a scale large enough to permit ready adaptation to heavy bomber production.

Greater numbers of two- and four-engine planes required a huge increase in engine production. Knudsen, wanting to get new capacity as quickly as possible, turned again to automobile companies for manufacture of engines under license from the established concerns. The Buick Division of General Motors and the Studebaker Corporation agreed to produce engines for the bombers under license from Pratt & Whitney and promptly undertook major expansions of existing plants or construction of new ones. Wright Aeronautical preferred to expand its own plants or to build branch factories rather than license other companies for production of its engines. The patterns established at this time, with Pratt & Whitney licensing other companies and Wright seeking to retain control of final assembly of its engines, persisted throughout the war.[36]

The British in October 1940 had urged consideration of additional construction to increase capacity to a maximum delivery rate of 4,250 planes per month by early 1942. At the time, Arnold opposed any further increase on the ground that it would "overtax the aircraft industry to a point where the efficiency of the industry may be seriously jeopardized."[37] But requirements, both British and American, continued to grow, and at the end of the year Robert A. Lovett, then Special Assistant to the Secretary of War, suggested that monthly

productive capacity be increased to 5,000 planes.[38] In February 1941 Lovett again recommended to Stimson that additional plant be provided, and OPM made similar recommendations, pointing out that the President's goal of an annual production of 50,000 planes could not be met with existing and projected facilities.[39] The adoption of lend-lease in March and the President's acceptance in May of a program for the production of 500 four-engine bombers per month removed the question of a further expansion of plant from the area of debate. Four-engine planes required far more floor space for assembly than did the smaller single-engine planes, and they required far more materials, parts, and labor. More than that, as noted in earlier pages,* the whole trend of aircraft development during World War II was toward an increase of the size and weight of virtually every Air Corps model, and this trend, already apparent in 1941, would repeatedly require upward adjustment of estimates on needed plant capacity.

Fortunately, from the standpoint of construction if not of production, most of the new facilities already contracted for had not been completed and some had not even been begun. Much of the new expansion, therefore, could be secured by mere revision of previous plans so as to provide for larger facilities. To meet the augmented requirement for B-17's, the Air Corps and OPM organized a pool similar to that established for the manufacture of B-24's. Douglas and Vega agreed to produce B-17's under license from Boeing, and the three companies formed one of the most effective production teams of the war. Boeing agreed to enlarge its B-17 plant at Seattle and to build a new one at Wichita for B-29 production. Douglas contracted for a new B-17 plant at Long Beach, California, and Vega greatly expanded its plant at Burbank. In order to meet higher requirements for B-24's, the assembly plants at Tulsa and Fort Worth were to be expanded to permit assembly of 75 planes each per month instead of 50. Ford's Willow Run plant was to be enlarged by about 200 per cent for production of 150 "knock-down" assemblies and 200 complete "fly-away" planes per month.[40]

Greater engine capacity was to be secured by expanding the planned Ford and Buick output by more than 100 per cent. The Chevrolet Motor Division of General Motors agreed to construct two new plants for the manufacture of Pratt & Whitney engines, and the Jacobs Aircraft Engine Company undertook to enlarge its plant at

* See above, Chap. 6, *passim.*

Pottstown, Pennsylvania, in order to help meet requirements for training-plane engines.[41]

Hardly had these plans for upward adjustments become firm before the Victory Program of September 1941 raised the sights for aircraft production far beyond anything yet scheduled. Once more the new program gave heavier emphasis to the big bombers, and by November Echols and Knudsen (at that time Director General of OPM) were discussing expansion of heavy bomber production to a monthly rate of 1,000 by 30 June 1944.[42] Just after Pearl Harbor, Lovett made an official recommendation that this be the goal.*

Post-Pearl Harbor

On 7 December 1941, "not one of the new plants authorized after June 1940 and designed to build combat planes had yet produced a single plane; and none of them was destined to get into full production before 1943."[43] But much of the proposed expansion of existing plants had been completed, and these plants were ready to carry the burden of production through the first year of the war. As yet the vast automotive industry had been utilized for aircraft production to but a fraction of its potential capacity, partly because of its reluctance to convert, partly because of the resistance of aircraft manufacturers to proposals for such a conversion, and partly because it had not been economically expedient to divert the industry precipitantly from car and truck production.[44]

As former barriers to an all-out production effort disappeared, the government turned on full pressure. The AAF ordered construction of facilities to be placed on a 24-hour schedule and assumed the increased cost involved.[45] Once more the upward revision of aircraft requirements forced reconsideration of a program of plant expansion to which the government already had committed above a billion dollars. On 16 December 1941 Lovett recommended that "steps be taken at once to develop a program for conversion of existing plants engaged in other types of manufacture, for construction of new plants and facilities, particularly for aircraft engines, for all Government furnished equipment," and for all other items connected with aircraft. He now proposed that heavy bomber production be increased to 1,500 per month and that other combat types be increased 25 to 35 per cent above their scheduled maximum. On 7 January 1942

* See above, p. 277.

Stimson further increased the heavy bomber goal, notifying Knudsen that provision should be made for the production of 2,000 heavy bombers per month at the earliest date.[46] Production planning anticipated to a very large extent the new goals announced by the President on 6 January.

To provide additional airframe capacity the government contracted for six huge new assembly plants. Bell, at Marietta, Georgia, and the Fisher Body Division of General Motors, at Cleveland, would build B-29's,* while North American would produce B-24's at a new plant in Dallas. The need for increased production of transport aircraft would be met by plants at Oklahoma City and Chicago, to be operated by Douglas, and by a plant at Kenmore, New York, to be operated by Curtiss-Wright. Republic Aviation, whose new P-47 looked like the answer to the AAF's need for an outstanding fighter plane, would build and operate a new plant at Evansville, Indiana, and enlarge its home plant at Farmingdale, Long Island. The smaller companies—Aeronca, Bellanca, Fairchild, Beech, Northrop, Howard, McDonnell, Globe—which had been expanded very little before Pearl Harbor, were provided with funds for new plants or extensions to existing ones. The vastly increased demand for trainers and light transports, which these companies were equipped to build, brought them into the class of major contractors for the first time. Previously, the AAF had regarded them chiefly as subcontractors for the larger companies.[47]

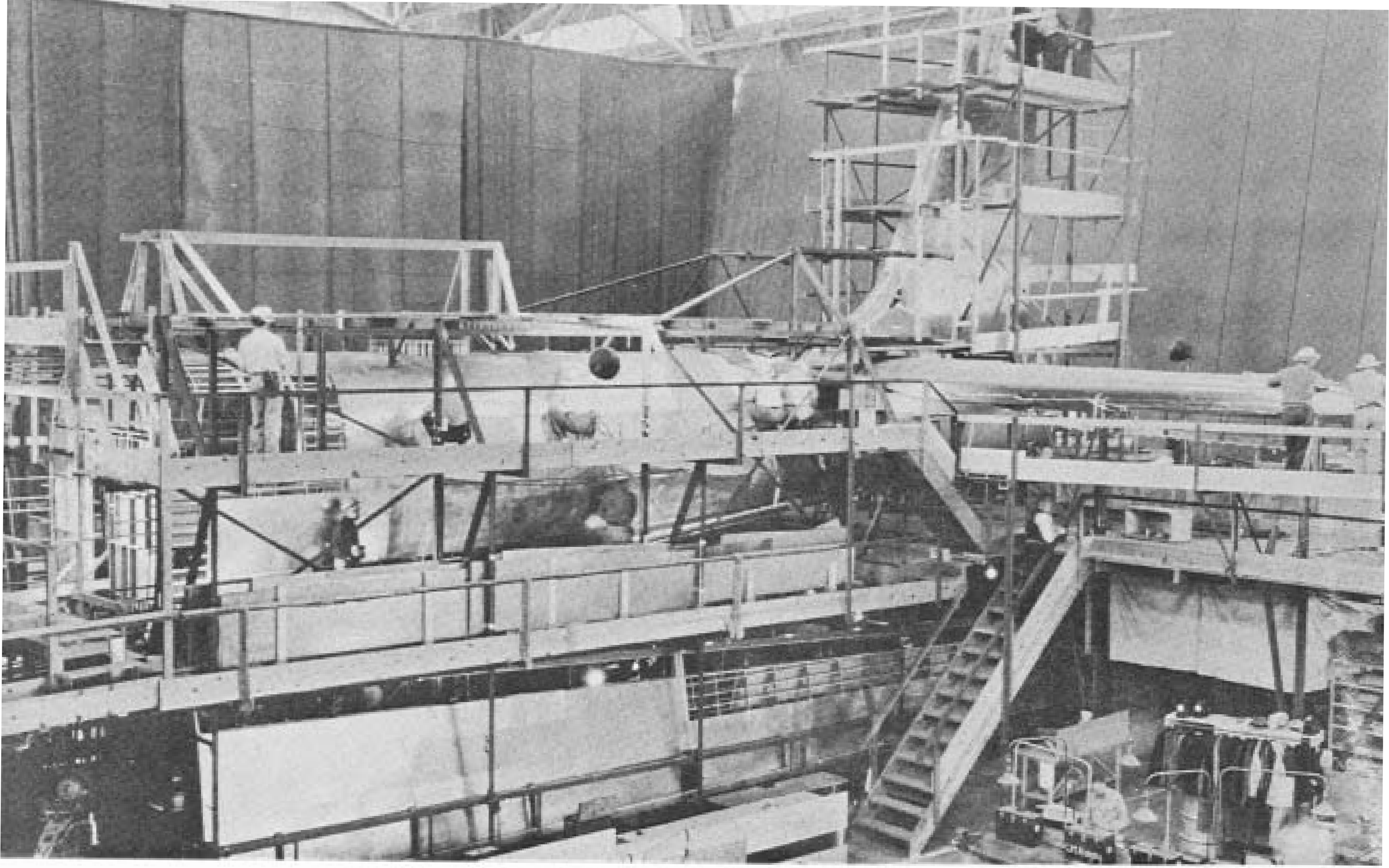
Allison, Buick, Chevrolet, Ford, Studebaker, and Wright Aeronautical all enlarged their existing facilities for engine production, while the Dodge Division of the Chrysler Corporation undertook construction in Chicago of what eventually became the largest plant sponsored by the AAF. Larger than the more publicized Ford plant at Willow Run, it eventually cost $173 million, including tools and equipment, and had a floor area of 6,430,000 square feet—an area equal to the entire floor space of the aircraft engine industry on 1 January 1941. The Continental Aviation and Engineering Corporation built a new plant at Muskegon, Michigan, and Wright later built a large plant at Wood-Ridge, New Jersey, in addition to expanding its Lockland plant. Production facilities for generators, superchargers, magnetos, piston rings, and other components underwent a comparable expansion.[48]

* Fisher Body never assembled B-29's but built parts and subassemblies.

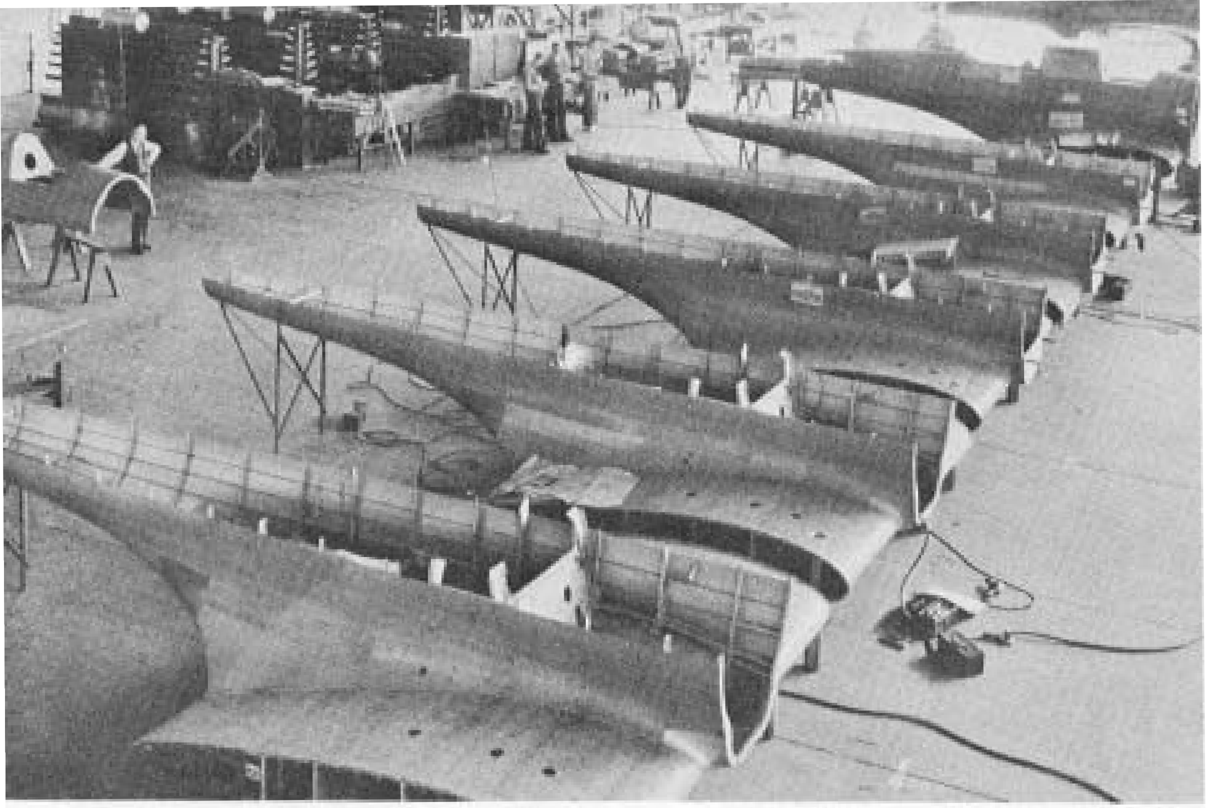
By the end of 1942 it was apparent that the industry would eventually have the plant capacity, if not the materials and tools, with which to meet the set production goals. Sums authorized after that year for new construction represented little more than 20 per cent of the total expended between 1940 and 1945. Some construction that might have been necessary later in the war was avoided by release of existing plants by other branches of the service, and particularly by the Ordnance Department.[49]

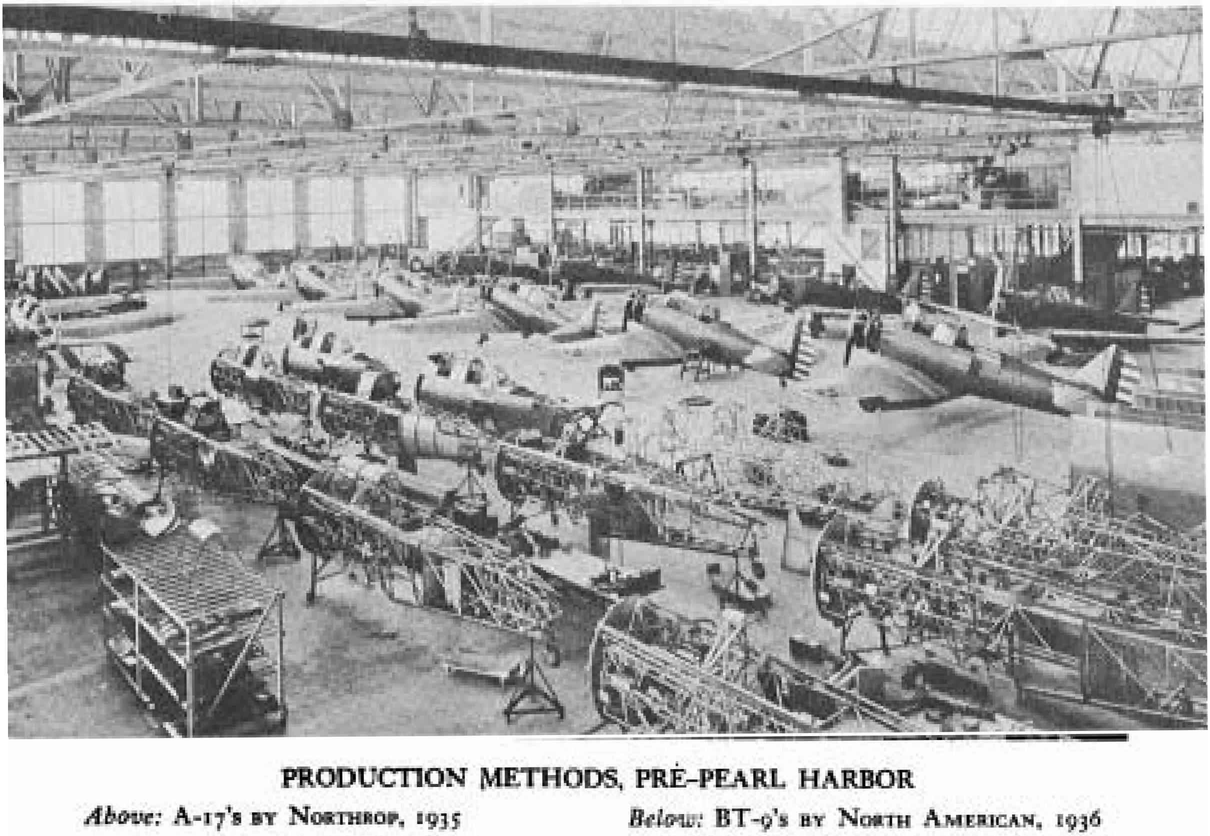
After 1942 a number of new plants were built to manufacture propeller blades, wings, turrets, and superchargers for B-29's. New plants for the production of cargo planes were built by Higgins Aircraft, Inc., at New Orleans and by Fairchild at Hagerstown, Maryland. The Higgins venture was one of the AAF's more expensive failures, for the New Orleans plant, at a cost of more than $23 million, produced only two C-46's before the end of the war. The AAF got better returns from its sponsorship of the construction of nineteen modification centers at a cost of more than $75 million during late 1942 and 1943. During 1944 the AAF authorized large expenditures for construction of two engine plants to relieve a shortage of Rolls-Royce Merlin engines—one $40 million plant for the Continental Aviation and Engineering Corporation at Muskegon, Michigan, and a much smaller one for Packard at Toledo, Ohio. It was accepted that these plants could not get into full production before sometime in 1945. In July 1944 General Electric was authorized $25 million for conversion of a turbine plant at Syracuse, New York, to build I-40 jet engines. Other expenditures for facilities during the last eighteen months of the war were chiefly for retooling and for small extensions to existing plants. Expenditures for retooling were large, costs for individual plants ranging up to more than $18 million.[50]

In 1942 there were indications that the country had an excess of facilities for munitions production, and by the end of 1943 there could be little doubt of it. Surpluses of machine tools, noted in 1942, became substantial by the middle of 1943. Utilization of plants and tools was considerably less than planned, with few companies actually operating at full capacity. In May 1942, for instance, a number of major contractors, including Lockheed, Boeing, and North American, were working only five-day weeks, three shifts per day, at some of their plants. In December 1942 Arnold told his staff that the plants at Tulsa, Fort Worth, Kansas City, and Omaha were operating at 20



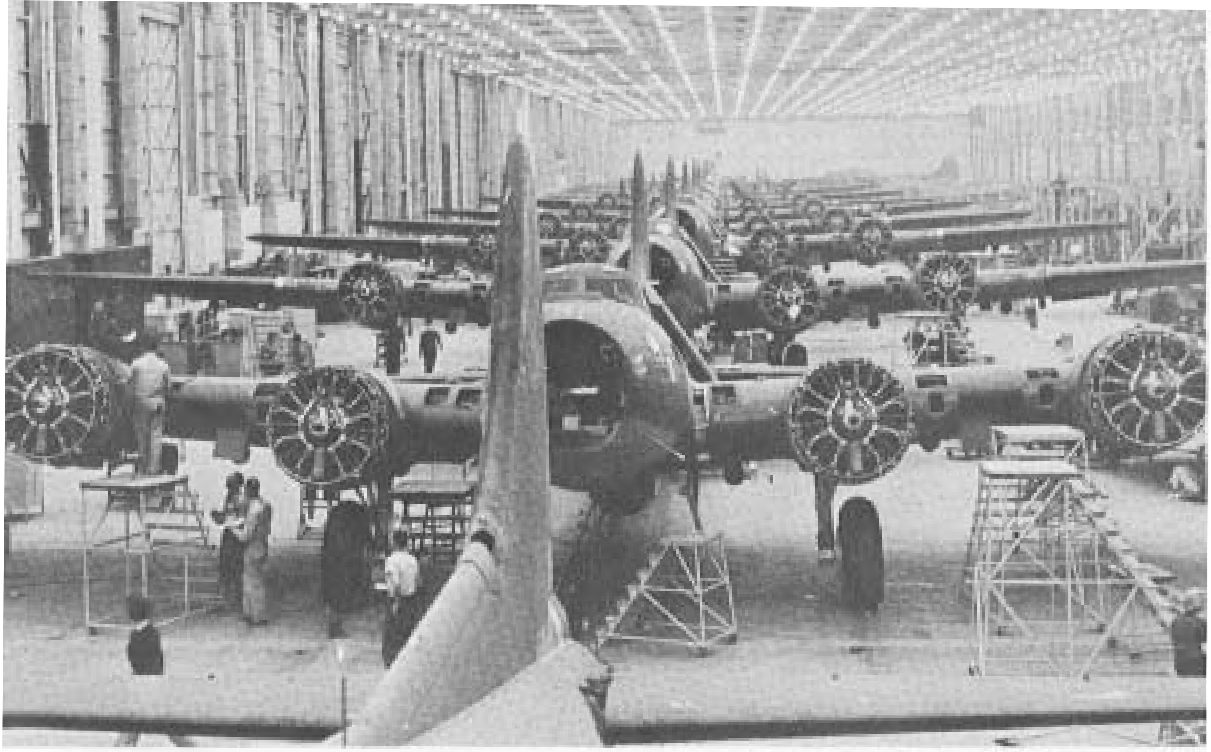
CONSTRUCTION OF EXPERIMENTAL MODEL, DOUGLAS XB-19





PRODUCTION METHODS, PRÉ-PEARL HARBOR

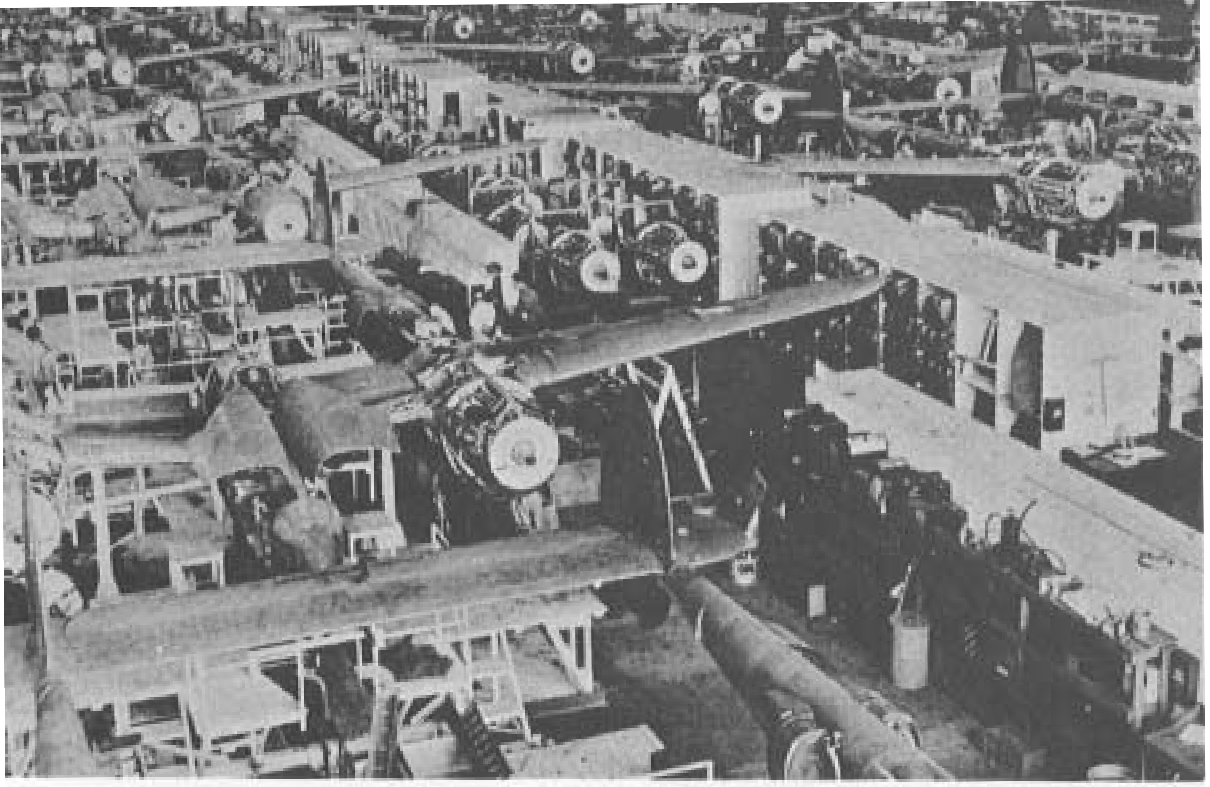
Above: A-17's by Northrop, 1935 *Below:* BT-9's by North American, 1936

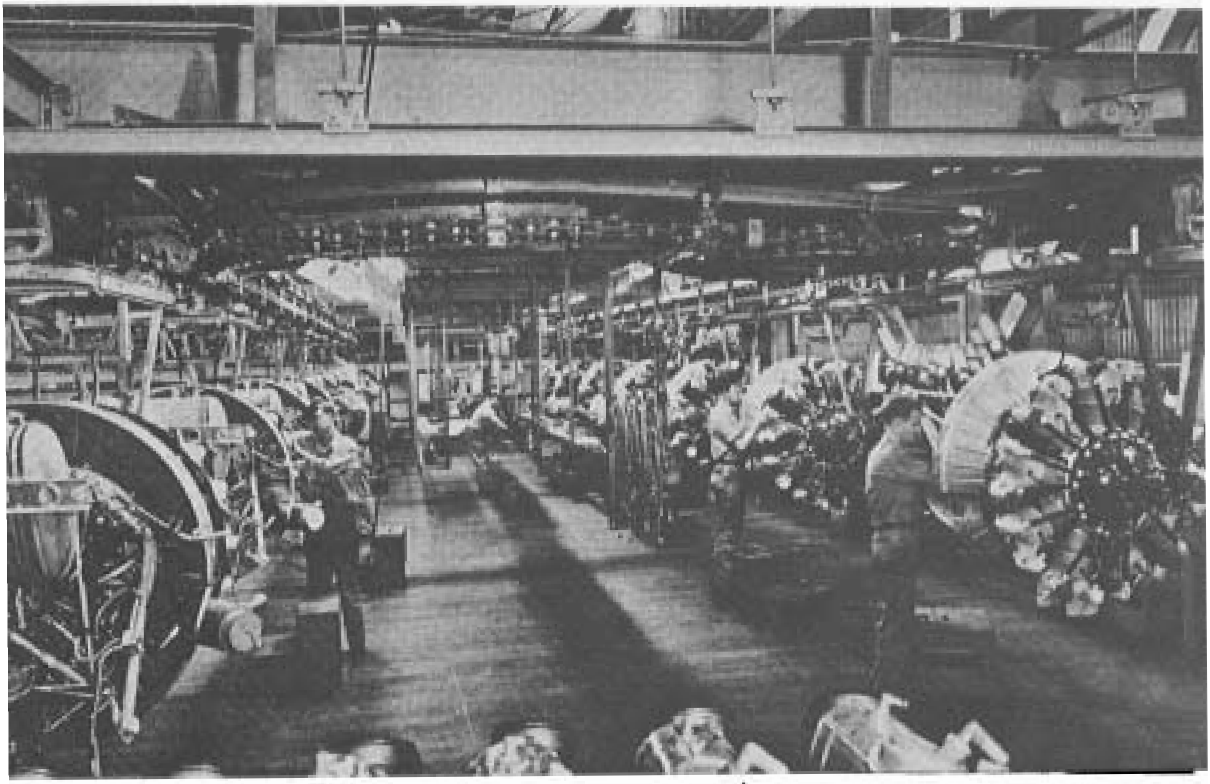


PEAK PRODUCTION OF HEAVY BOMBERS

Above: B-17's in Douglas Plant, Long Beach, Calif.

Below: B-24's in Consolidated Vultee Plant, Fort Worth, Tex.





MECHANIZED CONVEYOR LINES

Above: Triple Line for Lockheed P-38's

Below: Engines for Consolidated Vultee BT-13's

per cent of capacity or less. But these were all new plants which were just getting into production and would not reach full operation until late in 1943. Another factor which helped create an excess of facilities was the improvement of production techniques which resulted in much higher productivity per square foot of floor area than had been anticipated. Although deliveries were usually behind schedule, this was not caused by lack of facilities but by a failure to get them into full production on schedule. And the reasons for this were to be found in poor management, shortages of materials and labor, and other difficulties. It seems clear that during 1944 the country had the facilities to produce more munitions than it actually did, but the requirements did not exist. Indeed, aircraft programs were actually cut back during the year, and the number of employees in aircraft plants under AAF cognizance declined by more than 20 per cent.[51]

Why then, if there were excess facilities in existence, did the AAF authorize expenditure of more than $600 million in government funds for facilities during 1943–44? For the most part, these expenditures appear to have been necessary. A large portion went for expensive retooling of plants, including those of subcontractors, for production of later models of planes, engines, and other equipment; such retooling usually did not require new construction. Some of the funds were used for research and development facilities. Production of new types of planes, like the A-26 and the C-82, and new types of engines, especially jets, required new or additional facilities, because the companies which undertook to produce them had no others available. Although from time to time some plants were declared surplus, these were not always capable of adaptation to production of the desired planes or engines.[52]

The government provided 89 per cent of the $3,840,000,000 invested in aircraft plants between 1940 and 1945, most of it through the Defense Plant Corporation. This was almost one-sixth of the $25 billion invested in American manufacturing facilities, including plants, tools, and conversions, during the same period. The AAF sponsored direct government financing of more than $3 billion in aeronautical facilities, and the government financed indirectly, chiefly through accelerated tax amortization, the remaining amount. The largest share of the money expended under AAF cognizance, about 61 per cent, went for machinery and equipment. Only 35 per cent was for construction and alteration of buildings and 4 per cent for land, land im-

provements, and miscellaneous items. Machine tools were the most important single item. At the end of 1944, according to one estimate, the government owned approximately 55 per cent of the facilities producing AAF materiel.[53]

The AAF sponsored the expansion of 57 airframe, glider, and subassembly plants; 18 modification plants; 8 engine plants; and 107 parts and accessories plants. Of the total of 290 government-sponsored plants (100 of them for the Navy), 61 cost more than $5 million each and represented three-fourths of the total government investment of $1,401,000,000 in land and buildings and 54 per cent of the $2,303,000,000 investment in machinery and equipment.[54]

Other measures of the increase in capacity are more revealing than the moneys expended or the number of plants involved. The expansion of floor space was as follows:

Date	*Airframe*	*Glider*	*Engine*	*Propeller*	*Total*
		(In thousands of square feet)			
1 Jan. 1940	9,606	....	3,018	492	13,116
1 Jan. 1941	17,943	....	6,463	1,050	25,456
Jan. 1943	77,536	2,486	31,829	5,240	117,091
Dec. 1943	110,423	3,558	54,189	6,835	175,005
Dec. 1944	102,951	1,664	54,888	7,888	167,391

In terms of pounds of military airframes accepted, excluding spares, the increase in production was more than 4,000 per cent between 1940 and 1944. Production of combat-engine horsepower, including spares, increased more than 2,800 per cent between 1940 and 1944.[55]

Most of this enormous increase came from plants or plant extensions built after 1939. The new assembly plants, located chiefly in the Middle West, produced better than 35 per cent of the total airframe poundage between 1940 and 1944. Most of the engines manufactured during the war came also from new plants. Although a number of companies outside the industry engaged in manufacture of aircraft and engines, the established major aircraft companies continued to dominate production. Outside the established airframe industry, only Ford and the Eastern Aircraft Division of General Motors assembled aircraft on a large scale. Ford's Willow Run plant ranked fourth among all plants in pounds of airframes accepted for the period 1940–44 and stood first in 1944. Twelve major prewar plants,* greatly en-

* Bell at Buffalo; Chance Vought at Stratford, Conn.; Curtiss-Wright at Buffalo; Grumman at Bethpage, N.Y.; Martin at Baltimore; Republic at Farmingdale, N.Y.; Boeing at Seattle; Consolidated at San Diego; Douglas at Santa Monica, Calif.; Doug-

larged by extensions, produced more than half of the airframe poundage (excluding spares) accepted between 1940 and 1944. The engine industry, to a much greater extent than the airframe industry, had to depend on licensees, almost all of them with the automotive industry. Automobile firms assembling engines as licensees produced more than half of all the engine horsepower delivered between 1940 and 1945.[56]

The majority of the new plants producing for the AAF got into full operation in 1943, the lag between initiation of construction and full operation ranging up to three and one-half years. The average elapsed time for an assembly plant was thirty-one months, of which eighteen months were required to bring out the first acceptable model. Fighter plants got into production more quickly than did the bomber plants. To expand a plant already in production and to bring it up to a revised schedule required about twenty-one months on the average. To change an operating plant from production of one type of plane to another type and to get it into full production required an average of twenty-eight months. This lag was less serious than it seems, for production of the first type was usually being tapered off while preparations were being made for the second, and the actual loss of time was therefore much less than twenty-eight months. To the surprise of the experts, who had expected assembly plants to get into production more quickly than engine plants, it took only twenty-three months to build a new engine plant and to get it into full operation. It took about the same length of time to convert an automotive engine factory to full production of aircraft engines. This was because the construction of the special machinery took about as long as the construction of a new plant. All in all, it usually required less time to convert a facility than to build a new one.[57]

Conversion of the Automotive Industry

The aircraft industry alone could not have achieved the remarkable production record of the years 1940–45. Its resources in 1940 were too limited to have permitted an expansion on the scale required. The additional resources of managerial and engineering talent and, to a lesser extent, of machinery and facilities, came chiefly from the giant automotive industry which, to most Americans, was the embodiment of the principle of mass production.

las at El Segundo, Calif.; Lockheed "B" at Burbank, Calif.; and North American at Inglewood, Calif. All of these plants except Chance Vought, Grumman, and Consolidated Vultee were under AAF cognizance during the war.

At first the aircraft manufacturers had consistently opposed the use of the automotive industry for the production of aircraft. The Air Corps, though giving early thought to the need for a different policy, agreed that automotive firms would not be treated as prime contractors for airplane production but only as subcontractors to the aeronautical firms, who should be left free to subcontract to companies of their own choice. The automotive industry, on its part, did not look on aircraft production as a fertile field, preferring not to venture into an industry which apparently offered greater problems and smaller returns than did the manufacture of cars and trucks.[58]

After the President's announcement in May 1940 of an annual aircraft production goal of 50,000 planes, there was much speculation in the press as to the part that would be played by the automotive industry. This speculation received encouragement from Henry Ford's announcement that he could produce 1,000 airplanes of standard design per day, and even Knudsen, who was in better position to understand the realities of aircraft production, was quoted as mentioning the "possibility that General Motors could produce 1,000 war planes a month." But aircraft manufacturers, even during the summer and fall of 1940, continued to look with disfavor on proposals to use the automobile companies, and the latter, well embarked on their most prosperous period since 1929, showed even less inclination than before to devote any large part of their plant to aircraft production. Packard and General Motors, whose Allison Division became the third-ranking producer of combat aircraft engines in the country in 1940, helped in the solution of special problems, but the Air Corps still had no plans for the wholesale conversion of automotive facilities to aircraft production. Knudsen, himself one of the titans of the automobile world, announced in August 1940 that aircraft orders were not being placed with automobile companies because War Department plans called for their conversion only in the event of war. Until then, the NDAC did not propose to disrupt the peacetime schedules of the automobile companies.[59]

Since the differences between the production of automobile and aircraft engines were considerably less than those involved in the manufacture of automobile bodies and airframes, it was a natural development that brought the automobile industry into the aircraft program first for the production of engines.* The next step resulted

* It should be noted that neither the Ford contract nor the earlier Packard contract involved the conversion of automobile plants then in operation. Packard converted

from the growing concern for augmentation of the bomber program. At a meeting in New York on 15 October 1940 with leaders of the industry, Knudsen presented an appeal for help in producing medium and heavy bombers, and this conference was followed ten days later by one in Detroit that included representatives of both the aircraft and automotive industries.[60] Knudsen asked the automobile manufacturers to produce parts and subassemblies for 4,000 heavy bombers and 8,000 two-engine bombers, and urged them to conduct an over-all study, in conjunction with the aircraft manufacturers, of the production problems involved. Each company was to use its existing facilities and tools, plus such tools as its own tool and die makers could provide. There was no discussion of new plants, and it was clear that the automobile people would be subcontractors to the aircraft manufacturers who would assemble the planes in the new plants to be built by the government. Knudsen's objective at this time was a limited one, and there was no suggestion of conversion of the industry on a large scale.[61]

At the government's request, the industry subsequently established in Detroit an Automotive Committee for Air Defense and began surveys of available plant in order to determine what it could contribute to the program. The Air Corps stationed Maj. James H. Doolittle in Detroit as its liaison officer to assist the industry in its planning. As the bomber program took shape during the following winter and it was decided to construct four bomber assembly plants for operation by aircraft companies, Chrysler, Ford, Hudson, and the Fisher Body Division of General Motors became subcontractors for the manufacture of parts and subassemblies.[62] But the government found it necessary to provide far more funds for plants and machine tools than had been anticipated. According to General Echols, the original plan "called for the maximum use of all existing facilities and . . . no new facilities were to be financed by the government or the automobile industry for the specific purpose of building these airplane parts unless it was absolutely necessary." Echols was disturbed at the failure of the "haves" in the automobile industry—General Motors, Ford, and Chrysler—to use, via subcontracting, the idle facilities and machines of the "have nots"—Willys-Overland, Graham-Paige, and others—and at their insistence on new facilities and tools.[63] After OPM

an unused Detroit plant and Ford engaged to build a new plant adjacent to its River Rouge plant at Dearborn at a cost of more than $20 million.

had decided in January 1941 that there should be no curtailment of automobile production during the first half of 1941, the larger companies succeeded in obtaining government authorization for new plants and machine tools on the ground that they were necessary to the fulfillment of commitments to the aircraft program. Ford's new plant at Willow Run was financed by the government, and Chrysler, Hudson, and Fisher Body all secured aid in the rehabilitation of existing plants. New plant added by Chrysler, as previously noted, was privately financed.[64]

The role of the automobile industry in the expanding preparedness program had become a topic of nation-wide discussion and controversy as a result of the publication in December 1940 of the so-called Reuther Plan. Late in the month and with the support of Philip Murray, president of the CIO, Walter P. Reuther, head of the United Automobile Workers, presented to a group of government officials a plan for the production of 500 fighter planes a day by the automotive industry without reduction of its normal operations. The proposal rested upon the argument that 50 per cent of the existing capacity of the industry was unused, that automobile engine plants could be readily converted to production of aircraft engines, and that the industry had both the tools and skilled labor necessary for the manufacture of wings and fuselages. He recommended that machine tools be pooled and that an aviation production board, including representatives of labor, organize and supervise the program.[65] The proposal captured the imaginations of some government officials and much of the public. But neither the aircraft nor the automobile manufacturers could see much merit in the plan. The *Wall Street Journal* reported that holders of "aircraft shares are not particularly pleased at the prospect that the automobile industry may use some of its facilities for mass production of planes."[66] Leaders of the aircraft industry were skeptical or scoffed at the idea of mass production of planes in a fashion comparable to that of automobiles. The automotive industry considered the plan technically unsound, and looked with distaste and even alarm on the suggestion that labor participate in the management of the proposed program.

The real question was the extent to which automobile plants and tools could be converted to the production of aircraft. In October 1940 the Air Corps had felt that automobile factories could not be used for airplane assembly plants without extensive alterations because

they lacked sufficient space and clearances for large-scale aircraft assembly. And since it might take as much as twenty months to build new assembly plants, there appeared to be no reason for great haste in converting the automobile plants to the manufacture of parts and subassemblies, a conversion that would require much less than twenty months.[67] During the course of the debate over the Reuther Plan, estimates of the degree to which automobile plants could be converted to munitions production ranged from 10 to 50 or 60 per cent. The automobile companies maintained that only 10 or 15 per cent of their machine tools could be converted to the manufacture of munitions; the machine-tools industry and labor leaders placed the figure at 50 per cent. In the light of later developments, which in June 1942 saw a 66 per cent conversion of machine tools in the automotive industry, it seems that the automobile companies, granting their sincerity, were nevertheless inclined to minimize the possibilities for conversion.[68] On the other hand, it may be questioned whether Reuther was right in his assumption that so large an aircraft program could have been undertaken without reducing the production of automobiles. It was his contention that idle facilities could be used with a resulting increase of employment and without cutback of normal production.

The Reuther Plan received a hearing from Knudsen, but its proponents could not develop a comprehensive program without the active cooperation of the automotive industry, and this was not forthcoming. Accordingly, by the end of January 1941 the plan was dismissed from further serious consideration by the government, and public discussion of it soon declined.[69] From the point of view of defense needs, the chief weakness in the Reuther Plan was that it proposed to produce a weapon in much greater number than the Air Corps and the RAF needed.* Bombers, not fighters, had become the chief production problem by the fall of 1940, and a sufficient productive capacity for fighters already existed or could be readily provided. Making a standardized fighter plane in enormous quantities would not only have completely unbalanced the American and British air forces, but it would have consumed resources needed for production of other types of planes, especially bombers. The proposal apparently

* Although Reuther maintained that his plan could be adapted to production of bombers also, in smaller numbers than fighters, this aspect of his plan received little attention because of the spectacular effect of his mention of 500 fighters per day.

depended too much also on a false assumption as to the readiness with which Air Corps models could be frozen for purposes of mass production. Experience between 1940 and 1945 repeatedly demonstrated that the swift pace of aeronautical and tactical development denied the opportunity to freeze a given model for more than a very short time. Had existing models of 1940 been frozen for production on the scale proposed by Reuther, the results might have been disastrous.

Meanwhile, more automobile companies had agreed to join the ranks of those producing aircraft engines. In December 1940, the Studebaker Corporation received a contract for production of Wright R-2600 engines, and in January 1941 Buick Division of General Motors accepted a contract for Pratt & Whitney R-1830 engines. Both companies were to build new plants instead of using their existing ones. By this time it was clear to both the Air Corps and the OPM that no one of the automobile companies would sacrifice its competitive position in the industry by converting its own existing facilities unless all of its competitors did likewise. The only alternative was to provide them with new facilities and tools, and this the government felt obliged to do.[70]

The mounting pressure for aircraft production during 1941 continued to focus attention on the automotive industry even after the Reuther Plan was dismissed from consideration. Lovett, obviously aiming his remarks at the automotive industry, had suggested at the very end of 1940 that "certain existing facilities should be promptly diverted to war plane and engine production." He thought that the time had come "to compel, if necessary, the big aircraft companies to sub-contract their work where this can be done without jeopardizing quality."[71] But there was another aspect to the problem in addition to that of providing more facilities for manufacturing airplanes. The rapid and continuous increase in automobile production was consuming large quantities of metals and other materials needed for the production of aircraft and munitions.* The economic power of the automobile industry permitted it to compete successfully with defense production for these materials and for equipment and services vital to both. Here was a more compelling reason for converting the automo-

* The automobile industry estimated that in 1939 it used 18 per cent of all the steel used in the United States, 34 per cent of the lead, 80 per cent of the rubber, 23 per cent of the plate glass, 13.7 per cent of the copper, 11.4 per cent of the tin, and 9.7 per cent of the aluminum.

tive industry to aircraft production than was the need for more facilities. The necessity to choose between "guns and butter," or at least to readjust the existing balance between the two, became too pressing to be avoided, and on 3 May 1941 OPM issued an order curtailing automobile production by 20 per cent for the model year beginning 1 August 1941. The automobile industry used the intervening period to stockpile materials, especially steel, and to drive production of cars and trucks to new heights since the reduction after 1 August would be based on the rate of production for the previous twelve months.[72]

The curtailment of civilian production in the durable goods industries, of which the automotive was the largest, promised no quick solution to the problem of munitions production. Knudsen hesitated to cut civilian production drastically because the defense orders already placed were not sufficient to make use of the industrial capacity and manpower which would be released; the resulting unemployment and dissolution of pools of skilled labor could have serious economic consequences. On the other hand, shortages of tools and materials were delaying munitions production, and the lack of productive capacity had deterred the armed services from placing the heavy load on industry which the OPM believed should be placed on it. The massive nature of the arms programs made it impossible to achieve a quick and smooth transition, but action had to be taken to meet military requirements. On 9 July 1941 the President expressed his belief that the durable goods industries must be used for defense production, even though the conversion period might be costly to the government. By 21 August, the government and the automotive industry had agreed on a gradual reduction of passenger-car production totaling 43.4 per cent during the year beginning 1 August 1941. It is clear that the prime motivation for curtailment was conservation of critical materials rather than release of productive capacity. Consequently, it was not until after Pearl Harbor that the conversion of automobile plants to munitions production began in earnest.[73]

As aircraft requirements, particularly for bombers, mounted sharply during 1941, the government directed the automobile firms already participating in the aircraft program to revise their plans for new factories to include large expansions of capacity. In addition, Chevrolet Division of General Motors became an aircraft engine manufacturer and began construction of two new plants with government financing. As of 15 October 1941, the automotive industry held $914 million in

aircraft contracts from the government, approximately 48 per cent of the total defense contracts held by the industry. Most of these contracts were for aircraft engines, the chief exceptions being bomber contracts with Ford and propeller contracts with Nash-Kelvinator.[74]

The contribution of the automotive industry to munitions production, and especially to aircraft production, was small prior to 1942. During 1940 it delivered war products valued at $141,575,000, approximately 4.7 per cent of the $3,016,223,064 valuation of its automobile and truck production. Aircraft engines and parts were valued at $22,237,000, approximately 15 per cent of the total munitions production of the industry and the equivalent of .7 per cent of car and truck production. Most of the aircraft production for 1940 came from the Allison Division of General Motors. In 1941, the automotive industry produced munitions valued at $933,154,000, or 25 per cent of the value of the car and truck production, which amounted to $3,702,623,023. Aircraft engines and parts amounting to $178,333,000 made up less than 20 per cent of the total munitions production of the industry and amounted to only 4.8 per cent of the value of car and truck production. During 1940 more than 70 per cent of the industry's munitions production consisted of motor vehicles and parts, and during 1941 this category constituted more than 56 per cent of its munitions production. This type of production required little if any conversion of facilities.[75]

Pearl Harbor helped greatly to resolve the uncertainties and doubts which had characterized the industrial mobilization of the preceding eighteen months. There was less tendency thereafter to question the need for full mobilization of both industrial resources and manpower. Accordingly, the government undertook to convert as speedily as possible the durable goods industries to production of war munitions. If the conversion took longer than the exigencies of the times appeared to demand, it must be remembered that it was an extraordinarily complex operation which affected almost every facet of American life.

The automotive industry, already embarked on a munitions program which amounted to $4 billion at the time of Pearl Harbor, was the prime target for total conversion to war production. The War Production Board cleared the way for conversion by halting all passenger-car and light-truck production after 31 January 1942. The armed forces promptly began a race for the services of the industry,

letting contracts for huge amounts and authorizing conversion of its vast facilities. The industry organized the Automotive Council for War Production to expedite the effort and to deal with government agencies on industry-wide matters.[76]

The conversion of the industry, particularly to aircraft production, proceeded rapidly once it was undertaken. The increased aircraft goals announced by the President at the beginning of 1942 were accepted as a command by the AAF, which was spurred to almost frenzied activity in letting contracts and authorizing conversions of facilities. By 15 January 1942 the AAF had compiled a list of automobile manufacturers to whom it proposed to let contracts, totaling more than a billion dollars, for engines, superchargers, propellers, and governors. Contracts for airframes involved additional billions. The load on the industry mounted steadily, reaching a cumulative total of $15 billion for all munitions in June 1942, of which more than a third was for aircraft items.[77]

Also in June 1942 the industry finished the major part of its conversion to war production. About 66 per cent of the industry's machine tools were being used for war work, and much of the construction, involving extensions and new plants, had been completed or was well under way. Management and engineering staffs had studied aircraft production methods and received technical assistance from the aircraft companies. Training programs had prepared workers for doing new kinds of work. The economic effects of the changeover were less stringent than had been feared, and unemployment never reached the peaks anticipated, partly because of the speed of conversion.[78]

The expansion of automotive facilities undertaken after Pearl Harbor outdid anything that had been planned before. The government authorized expenditures for this purpose which far exceeded those made theretofore on behalf of the aircraft manufacturers. The six corporations receiving the greatest amounts of government funds for expansion in connection with aircraft production between 1940 and 1945 included General Motors, Curtiss-Wright, Ford, Chrysler, United Aircraft, and Douglas, in that order. The three automobile companies received more than $922 million as compared with $828 million for the three aircraft companies. General Motors, with $501 million, and Curtiss-Wright, with $425 million, received by far the largest amounts.[79]

The automotive industry built well over half of all the aircraft engines produced between July 1940 and August 1945, and probably two-thirds of the combat aircraft engines. In the peak month of engine production, August 1944, the automobile companies produced more than two-thirds of the total engine output and three-fourths of the combat engine output. Allison, the only one of these plants with prewar experience, produced its own V-1710 engine, while Packard made the V-1650 engine as a licensee of the British Rolls-Royce company. Dodge and Studebaker turned out Wright engines under license, while Buick, Chevrolet, Ford, and Nash-Kelvinator manufactured engines under license from Pratt & Whitney.[80]

Only Ford and the Eastern Aircraft Division of General Motors participated on a large scale in the assembly of complete aircraft as licensees of aircraft companies. Ford made a major contribution to the production of B-24's, while Eastern Aircraft at its two plants at Linden and Trenton, New Jersey, turned out a large number of Navy planes. Chrysler, Ford, Fisher Body, Hudson, and Nash-Kelvinator were the principal suppliers of airframe parts and subassemblies. Frigidaire Division of General Motors and Nash-Kelvinator produced propellers. It has been estimated that about 30 per cent of the total pounds of airframe weight produced was by subcontractors and almost 10 per cent by licensees. Almost all of the total in each category came from the automotive manufacturers.[81]

Relations between the aircraft and automotive industries were necessarily close, if not always cordial, during the war years. During 1940–41 the aircraft manufacturers had turned out practically all of the planes and engines produced in the country, while the automobile firms were still building the engine and airframe plants which made such a fine record in 1943–45. Much of the fear of competition which had always haunted the aircraft companies persisted after the war began and was reflected in their criticisms of the efforts of the automobile manufacturers.[82] In May 1942 James H. Kindleberger, president of North American, asserted that the automobile industry was a "bottleneck" in the production of parts and subassemblies for airframes.[83] Frederick B. Rentschler, chairman of the board of United Aircraft, was proud of his company's role in bringing the automobile industry into the production of aircraft engines even if that industry "should turn out to be a Frankenstein's

Monster and try to 'swallow up' the aviation industry after the war."[84]

As the automotive industry made a growing contribution to airplane production and the aircraft companies reached the limits of their expansion capabilities, criticism of the former diminished. But fear of competition continued to show itself in suggestions by the aircraft manufacturers in 1944 that subcontracting work being done by automobile companies should be transferred to their aircraft plants as facilities became available. This would permit the automobile manufacturers to reconvert their plants to automobile production. The automobile companies, which apparently had been looking ahead to postwar production as early as 1943, could not have been displeased by these suggestions. The end of the war found the automobile companies quickly reconverting to car and truck production and the original aircraft firms once again in control of their industry.[85]

The question of whether the automotive industry could be converted to production of aircraft was settled beyond debate during the war. The success of the engine plants left no room for argument, and the record in fabrication of airframe parts and subassemblies, after a slow start, was a good one. The experience in assembly of aircraft was on a smaller scale and less conclusive. The Ford venture at Willow Run was unique in its application of automotive mass production methods of aircraft assembly on a scale far beyond anything yet attempted. For a variety of reasons, many of them beyond its control, the company encountered great difficulties in adapting the B-24 to mass production, and perhaps the strongest criticism of its effort is the length of time it required to reach mass production. At one time, in September 1943, the Materiel Command despaired of the company's ability to meet delivery schedules and seriously suggested that the government take over management of the plant. Although this was found to be inadvisable, the War Department applied strong pressures which apparently had salutary results.[86]

Ford made a notable contribution to aircraft production, delivering a total of 6,791 B-24's between September 1942 and June 1945, 5,476 of them in 1944–45. It also delivered 1,893 "knock-down" units which were assembled by Consolidated Vultee* and Douglas. Ford reached a peak production of 428 B-24's in August 1944, and pro-

* Consolidated and Vultee merged in 1943, becoming Consolidated Vultee.

duced 92,568,000 pounds of airframes in 1944, the largest total produced by any single plant in the country. Willow Run's peak monthly output in airframe poundage was half the peak monthly output of the whole German airframe industry.[87] Although some aircraft manufacturers questioned whether the same results could not have been accomplished in less time and at smaller cost, it seems clear that the Ford experiment was ultimately successful. Given the limited capacity of the aircraft industry and the enormous pressure for plants after May 1940, it is fair to conclude that the AAF was justified in underwriting the Ford experiment.

CHAPTER 10

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THE PRODUCTION RECORD

THE United States produced almost 300,000 military aircraft in the 62 months between 1 July 1940 and 31 August 1945. During the same period it turned out 802,161 aircraft engines of all types and 807,424 airplane propellers. The total airframe weight, including spare parts, was 2,859,098,000 pounds. The cost of this aircraft program was almost $45 billion, or 24.5 per cent of the total American munitions program of $183 billion. Between 1940 and 1944, when peak production was attained, aircraft manufacture was transformed from a handwork to a mass production industry. During 1940, when the industry was just beginning its expansion, it produced approximately 13,000 aircraft, less than half of them military. In 1944 it turned out more than 96,000 military planes, very nearly 16 times as many as in 1940, and these were generally much larger and much more complex than those of the earlier year. Measured in terms of airplane weight, production rose from 24,600,000 pounds in 1940 to 1,101,116,000 pounds in 1944, a total 45 times as great. Military engine production increased from less than 16,000 engines in 1940 to 256,912 in 1944, more than 16 times over. If the total horsepower of the engines produced be taken as the index, the comparative figures stand at approximately 16,000,000 in 1940 and 431,282,000 in 1944, an increase roughly twenty-seven fold. The monetary value of the finished product increased 30 times over—from approximately $552 million in 1940 to $16,745 million in 1944.[1]

The floor space devoted to aircraft manufacture increased during these years perhaps as much as twelvefold, and the manpower employed perhaps sixteen fold.[2] A widespread use of subcontracting makes it difficult to get more exact figures,* but it is clear enough

* The floor-space increase for prime contractors was something like eight or nine times and the labor increase about ten times. But the increase in subcontracting made much additional floor space and manpower available, so that the over-all increase was probably as indicated above.

that new techniques of production played a more important part than did any other factor in making possible the remarkable record achieved.

The Assembly Line

Prior to 1939 there had been little reason for either airframe or engine manufacturers to use mass-production methods, for both military and commercial orders remained so small that an order for fifty planes rated large. Not only was the volume small, but frequent adjustments of design, even on a particular model, denied the aircraft manufacturer an opportunity to follow the pattern set by the automotive industry, where models could be frozen for at least a year of quantity production. If the aircraft industry showed the highest quality of craftsmanship in the work of its individual machinists, it also had failed to exploit fully two of the distinguishing features of our industrial society—the machine tool and the interchangeable part. Parts were usually run off in "job lots," and little attempt was made to break assemblies down into subassemblies. The parts were gathered in one place where the airplane was assembled from the floor up by highly skilled mechanics who made necessary adjustments as they built.[3]

By 1940 national policy demanded production in quantity as well as quality. Aircraft manufacturers, who recognized the need for a change of method if the set goals were to be met, sought first to persuade the government to freeze its aircraft designs. They pointed out that mass production could be attained only if planes and parts were standardized to permit scheduled production at steady rates.[4] Though it seemed to some authorities in the War Department, among them Lovett, that the industry lacked a desirable interest in improvement of production methods,[5] the Air Corps gave close attention to the possibility that its program of expansion might be built around a few models of proved design. But this hope proved to be an illusion. Since the AAF fought in so many theaters under such widely varied climatic and tactical conditions, it was often necessary to incorporate in any given model many changes dictated by differing requirements in the several theaters of war. Experience showed that the solution lay in full use of mass production of certain basic models which could then be adapted in AAF modification centers to the peculiar needs of the various theaters.

It took time, but by 1944 constantly moving assembly lines, equipped with a variety of precision tools, many of them newly developed, provided a steady flow of parts and subassemblies which merged into assembled airplanes at rates measured in hours and minutes rather than days or weeks.[6] Among the earlier assembly lines was the one which began operations in the North American plant at Dallas in May 1942. The most ambitious of early efforts to mass-produce airframes was made, as might have been expected, by an automobile firm: Ford made the attempt on a grand scale at Willow Run, establishing a full-blown B-24 assembly-line organization from the very beginning of operations. In spite of its great resources, however, Ford was later than most other airframe manufacturers in getting into production, encountering many difficulties in adapting automotive production methods to airframes and requiring more help from the aircraft industry than it had originally sought.[7] Nevertheless, it ultimately succeeded and in 1944–45 became the prime example of mass production of aircraft.

Assembly-line production methods permitted the use of large pools of unskilled labor which probably could never have been trained in time, if at all, to perform the varied skills required of the 1939 airframe or engine plant worker. Automotive precision tools made possible a new degree of specialization and substantially increased the product of the individual worker. The Aircraft Resources Control Office found that the individual employee's output of airframe pounds per working day rose from 1.05 in July 1941 to 2.70 in July 1944. At the same time, the man-hours spent in production of parts, subassemblies, and whole aircraft declined steadily, even after full production had been attained. The measure of the progress achieved is suggested by the following table of the actual man-hours required for the manufacture of complete airframes, subcontracted work and the installation of engines, propellers, and equipment being included:[8]

Plane	*Company*	*Jan. 1943*	*Jan. 1944*
B-17	Boeing at Seattle	35,400	18,600
B-24	Consolidated Vultee at San Diego	24,800	14,500
B-25	North American at Inglewood	14,800	10,700
C-46	Curtiss at Buffalo	113,000	49,500
C-54	Douglas at Santa Monica	142,100	62,600
P-38	Lockheed-"B" at Burbank	14,800	9,600
P-47	Republic at Farmingdale	22,200	9,100

Though the Air Corps and the Navy were never able to standardize their requirements to the full extent desired, they did make a helpful contribution to the improvement of production methods. Navy carrier planes could not be built to the specifications fixed for AAF aircraft, but many of the parts—bolts, nuts, pipe fittings, or pressure pumps—and much of the equipment—engines, propellers, and communications devices—used in the planes of the two services could be and were standardized. In response to pleas from the manufacturers and to an increasing sense of the necessity on the part of service agencies,[9] the Joint Aircraft Committee, after its establishment in September 1940, conducted a continuing investigation of opportunities for standardization of equipment employed by the two American services and the British.[10] British agencies cooperated by limiting their purchases to aircraft types used by the American services and by restricting to a minimum the special refinements desired by the RAF. It was easier to handle the problem for relatively simple training or cargo planes than for more complex combat types;[11] nevertheless, the effort to provide the maximum of standardization was continuous.

While the JAC and other agencies sought earnestly to reduce the differences among the aircraft and the items of equipment being produced for the air services, both technological development and tactical experience were pulling in the opposite direction. From the theaters of combat came a steadily mounting demand for modification of planes and equipment to meet the changing requirements of battle. It was a plea, of course, that could not be ignored, but the concurrent demand for maximum production was no less compelling. The answer to this dilemma came partly from the long experience of the Air Corps as a participant with the manufacturer in a common experimental venture. From the very infancy of the Army air arm, flyers, hoping for better performance, had been accustomed to tinker with and adjust their planes. Such ingenuity had not infrequently led to modifications incorporated by manufacturers in new models. It was but natural for those who had grown up with the Air Corps and who found themselves confronted in battle with a need for more range, more armor, or greater firepower, to turn first to their own resources and to get the desired change made through their own depots or even by their own ground crews. If the commanding general happened to be an engineer, as was Kenney in the Southwest Pacific, the number of attempted modifications of standard models might reach very im-

pressive proportions indeed.* In every theater the normal depot work of repair and maintenance was supplemented by a growing load of modifications in the continuing race to keep equipment abreast of the demands of battle. By 1944 the air service organization in ETO was devoting the greater part of the resources of two huge base depots—employing all told some 28,000 men—to aircraft modification.† Production of standard models thus could be kept rolling with some assurance that their adaptation to particular requirements would be provided for in the theater.

But this practice alone could not have sufficed. The number of modifications required—some small, some large—grew steadily. To relieve the pressure on the limited resources of the overseas air forces, it was desirable to incorporate the modifications as quickly as possible into the standard model produced by the manufacturer. Two factors, however, made this difficult. One was a consideration of time; major changes in a model, or even the incorporation of a good number of minor changes, could involve a serious delay in production with results affecting plans for the equipment of combat units. Moreover, requirements varied from theater to theater, so much so as to make it virtually impossible to introduce every needed modification into production models. The answer to these difficulties was found in the establishment of special modification centers in the United States.

The original impetus to set up these modification centers came from General Brett who, during a visit to the United Kingdom in the summer and fall of 1941, learned that the British had found it necessary to undertake a good many modifications on American-built planes, with a resultant strain on their depot facilities. He accordingly recommended that every effort be made to incorporate the maximum number of modifications required by the British before the planes were shipped to England.[12] This recommendation came at a time when there was already much concern over delays in production that were attributed to frequent changes of design,[13] and special modification centers seemed in the circumstances to offer a logical solution.

The Materiel Division proposed the establishment of ten modification centers,[14] the first of which began operating at Cheyenne, Wyoming, late in January 1942. Originally, it was expected that the aircraft manufacturers would each operate the modification center for

* See Vols. IV and V, *passim*.

† See Vol. II, 628–30, 661–63.

its own planes, but in this hope the AAF was destined to disappointment. Engulfed by the mounting demands for expanded production, the aircraft companies were in no position to take on the additional burden. Consequently, the AAF turned to the commercial airlines, whose maintenance shops contained the necessary facilities.[15] The American, Chicago, Mid-Continent, Northwest, Southern, and United airlines were among the first to respond to the AAF's appeal. The B-25's used in the Doolittle raid on Tokyo in April 1942 had been modified for their special mission in February by the Mid-Continent Airlines at Minneapolis, one of the first companies to get a modification center into operation. By July 1942 twelve centers were in operation, and the grand total ultimately reached twenty-eight, though there were never this many in operation at any one time. To provide floor space and necessary facilities, the government ultimately spent $100,000,000 on twenty-one centers, eighteen of them operating exclusively for the modification of AAF-type planes. At the peak of operations, the floor space had reached 5,000,000 square feet and the employees totaled more than 45,000 persons.[16]

Even so, demands for modification swelled to almost unmanageable proportions as the war progressed. In addition to the effort to keep up with the requirements of overseas air forces, the Navy, and foreign recipients, the modification centers also installed certain standardized items of equipment ordered by the Joint Aircraft Committee but not yet introduced into the production line; made changes found necessary for the safe and efficient operation of the plane; and attended to such maintenance work as might be necessary when the plane was delivered to the center. While getting the new centers into operation, the AAF leaned heavily on its own air service depots, which during the summer of 1942 were modifying planes at the rate of 500 per month; at the close of 1943 the Air Service Command found that modifications performed in its repair shops still represented 40 to 50 per cent of the work done. Attempts during that year to reduce the load by establishing two standardized sets of requirements for modification—one for planes assigned to European theaters and the other for aircraft scheduled for service against Japan—proved none too successful in the face of demands that continued to vary from theater to theater.[17] Not until the summer of 1944, when production had reached a point offering assurance that established requirements would be met, was it possible to take the risk of delay in production schedules by

making more modifications in the assembly line. In the preceding spring the responsibility of the Air Service Command for modifications had been limited to special projects, in the hope that a "single acceptance" policy—which is to say that modifications would be incorporated during production and before acceptance of the plane*—might eventually be achieved.[18]

The record makes it clear enough that the advantages of mass production in the aircraft program were gained only at the cost of a heavy burden of modification, and that at any time before 1944, that burden could have been substantially reduced only through unacceptable delays in production. Modifications ranged from the simplest to the most complex operations. The man-hours expended on a plane might vary from as few as a dozen to many hundred, with the heavy bombers requiring the fullest attention. The most common modifications involved the addition of armor and guns or communications and target-finding equipment, with the last changing very rapidly and becoming increasingly vital to operations. It might be necessary to alter the design and equipment of a B-24 for unanticipated service against submarines, or to modify another type for photo reconnaissance. Some planes required special protective devices against desert sands, others against the cold weather of arctic regions. Often the problem was to find room for more fuel, or for more bombs. With the B-29, which pre-empted much of the modification capacity during the latter half of the war, modification centers worked hard to take the "bugs" out of a plane that not only was hastily produced but in a very real sense had its service testing in combat.† The job usually was to add some new feature of design or equipment, or to make adjustments of existing equipment, but there were also instances in which devices incorporated in the standard model had to be removed before shipment to particular theaters. When hostilities ceased, only those modifications necessary for safety of operation or for experimental purposes were continued, and the responsibility for these fell now to normal agencies as the special centers were closed.[19]

At the other end of the production line the use by prime contractors of subcontracts with other firms for the production of special parts,

* By the end of August 1944 this policy had been agreed upon with the manufacturers of the A-20, B-24, B-25, B-26, and C-47.

† The center at Birmingham, employing 8,000 to 9,000 persons, devoted most of its capacity to the B-29 during this period.

equipment, or even subassemblies, served in important ways to keep assembly lines moving. A practice familiar enough in other industries, the aircraft industry, as has been previously noted, had had little cause to try it and at first showed a disinclination to test its advantages. Some of the smaller companies, notably Grumman and Brewster, turned to subcontracting as early as 1939, but the larger firms continued to fear the building up of potential competition, a fear reflecting the sharply competitive character of the aircraft industry during the interval between the two wars. Although the prewar plans of the Air Corps for industrial mobilization had assumed that it would be necessary to resort to large-scale subcontracting, it was not until 1940 that the volume of production required reached a point which seemed to justify putting official pressure on the industry to overcome its reluctance.[20]

But then other difficulties appeared. During 1940 and well into 1941, many small companies which could qualify as subcontractors preferred continuing normal production for the civilian goods industries to gambling on the munitions program. No small part of the more readily convertible firms had valued connections with the automobile industry, and until production of cars for the civilian market was cut back, it remained difficult for aircraft manufacturers to find companies willing to take subcontracts. As the munitions share of total production increased during 1941, however, smaller plants began to find themselves at a disadvantage because of difficulty in securing necessary equipment and material in critical supply. A contract with a company working for the government, and especially on some part of the aircraft program, could be helpful in getting supplies, and by the time of Pearl Harbor all parties were perforce inclined to be cooperative. With the coming of hostilities, a drastic curtailment of production for civilian consumption gave the smaller firms no choice. As for the other parties to subcontracts, the overwhelming load with which the aircraft industry had been saddled had largely removed its initial reluctance, and, for good measure, there was now added the strong political pressure for subcontracting which arose from the fear that the war might kill off small business firms as "big business" became bigger. The Air Corps had previously assumed that it lacked the information to guide contractors in their subcontracting. But the Materiel Division as early as December 1940 found it necessary to establish a special organization within its office for the purpose of

locating and making known to large manufacturers the potential capacity for this form of expansion. Working with WPB and the Smaller War Plants Corporation, the AAF throughout the war continued to help bring prime and subordinate contractors together.[21]

By January 1942 some of the aircraft companies were subcontracting as much as 50 per cent of their work.[22] It has been estimated that subcontracting accounted for approximately 30 per cent of the total airframe poundage produced during the war. In the field of aircraft engines the percentage probably ran higher, possibly to as much as 40 per cent. More exact figures are difficult to get, for the practice often involved several tiers of agreements, with one level of subcontractors further subcontracting to a lower level, and so on. For the B-24, Consolidated Vultee depended on as many as 100 subcontractors, some of whom, in turn, resorted to the same device. Subcontractors for the manufacturers producing the B-29 ran into the thousands. In 1943 Boeing was subcontracting more than 40 per cent of its B-17 work, and in 1944 Douglas subcontracted for 40 per cent of its output. One estimate placed the total number of subcontractors in the aircraft industry at more than 162,000.[23]

Some aircraft manufacturers remained skeptical as to the utility of subcontracting. They found it a singularly complex operation which sometimes placed a load on management as great or greater, it was argued, than that which it was supposed to relieve. The practice undoubtedly added complexity to problems of scheduling, design change, and transportation. One informed survey concluded that subcontracting was much more helpful for large sections and subassemblies of planes than for smaller parts.[24] Nevertheless, it seems safe to conclude that the maximum exploitation of the nation's manufacturing capacity could not have been attained as effectively nor as early by any method other than widespread subcontracting. In this, as with other problems affecting aircraft production, the main burden fell upon organizations outside the AAF. But the AAF, as the principal user of the product, could never be divorced from efforts to solve the varied problems of production. If its basic responsibility was that of the military expert whose function is to advise on the apportionment of productive capacity according to the need for specific weapons, the AAF also, and unavoidably, played a significant part in the development of that capacity.

Special Production Problems

The very novelty of the production techniques employed and the sheer size of the effort resulted in a variety of special problems. Among the more serious of these was the acute shortage of managerial and engineering talent. One study has concluded that the "time required for the peacetime aircraft manufacturers to expand their management personnel . . . and to mold their expanded managements into effective operating units was one of the principal factors limiting the speed of the wartime expansion."[25] The aircraft companies in 1940 had only a small nucleus of experienced men around which to build. At the end of 1938 the five leading airframe companies employed an average of 3,500 persons each, at the close of 1943 an average of over 100,000.[26] Early anticipation of the need for expanded managerial staffs fell far short of the actual requirement that developed.[27] As the automobile industry moved into aircraft production, administrative experience in the latter field took on a new premium. Military organizations drew into their service men for whom a greater need existed at their customary desks—a fact that is attributable not only to the government's failure to develop better policies for the use of manpower but to the psychological pressure that in time of war makes a man seek military service. The establishment of branch plants, most of them hundreds or thousands of miles from the home office, though offering the advantages of more readily available labor or better security, placed an additional strain on management by forcing it to multiply executive staffs and to resolve the difficulties of new and more complex administrative relationships. By no means least among the new burdens were those imposed by the proliferation of government agencies with which management had to deal on the complex details of contract negotiation or the procurement of tools and materials, not to mention the onus caused by the government's supervisory rights over a variety of jobs for which it was footing the bill. The demand for engineers so far exceeded the supply that some of them left established firms in order to make huge profits by setting up their own organizations.[28]

As late as March 1943 Charles E. Wilson, chairman of the Aircraft Production Board, attributed a current lag in aircraft production primarily to unsolved problems of management. On that occasion the AAF disagreed, placing the blame rather on a shortage of materials,[29] but at other times AAF leaders emphasized the important role of

managerial inefficiency in the difficulties experienced with particular plants and companies; more than once the AAF insisted upon the replacement of executives who were inefficient and recommended new ones.[30] It also rendered concrete assistance at points by releasing experienced executives from military service for more important tasks in production. The blame for these difficulties belongs both to government and to industry, but it would be unfair to close the discussion on a note of disparagement. It seems altogether unlikely that any other industrial group in the United States operated under such relentless strain and tension as was imposed on the aircraft companies and their staffs, managerial and engineering, by the demands of the wartime aircraft program. Their achievement was made a matter of record through one of the great military triumphs of the nation's history, and in the final balance that achievement outweighs all shortcomings and failures.

During the period from 1940 through 1942 shortages of machine tools also caused trouble. In this area, although the machine-tool industry had always been a small and highly specialized one whose limited capacity could not easily be expanded, the aircraft program, and thus the AAF, fared relatively well. The expansion of aircraft production got a sufficiently early start to give the industry some advantage in the competition for the limited supply of machine tools. As early as 1940 the aircraft industry purchased more machine tools, for the first time in its history, than did the automotive industry, long the largest user of machine tools in the country.[31]

But there was trouble before the end of 1940. In October of that year the Air Corps requested the Administrator of Export Control to refuse licenses for export of all machine tools that could be used in aircraft manufacturing.[32] The urgent needs of the British, and later of the Russians, made it inexpedient to impose a ban on the export of all machine tools, and lend-lease contributed in part to subsequently developing shortages.* The extent to which these shortages were responsible for production delays cannot be expressed in statistical form. At some time or other between 1940 and 1943 almost every major aircraft manufacturer, and more particularly the producers of aircraft engines, ascribed their production problems chiefly to machine-tool shortages. In the spring of 1941 Curtiss-Wright, Ford, Allison,

* In 1942 the U.S. supplied Britain with 47,000 machine tools, of which 18,000 were used in the aircraft industry.

and Continental Motors were all behind in engine deliveries because of lack of machine tools; at other times, Bendix, North American, Douglas, Pratt & Whitney, Packard, Lockheed, Republic, Martin, and others also fell behind for the same reason. The Martin plant at Omaha, which was supposed to be completely equipped by 1 January 1942, had only 50 per cent of its machine tools by that date. In 1942 Vega and Boeing were handicapped in production of B-17's by shortages of machine tools, and in 1943 late deliveries of tools delayed the Bell plant at Marietta in getting into production of B-29's, although there were also other more important reasons in the latter case. The effect of these shortages reached down to the lowest tier of subcontractors. Often delivery of engines and airframes was delayed because parts and subassemblies were received late, their production, in turn, being delayed by lack of machine tools or of other parts for which machine tools had not been available in sufficient quantity.[33]

The AAF served to bring these shortages to the attention of the proper authorities and to make recommendations on desired priorities. It also threw its influence into an effort to secure more effective policies and machinery for control of the distribution of machine tools. After Pearl Harbor there was established a government pool of the commonly used tools for assignment, by lease or purchase, to the manufacturers,[34] and this move proved very helpful. By the end of 1942 the aircraft industry was largely tooled up.

As the machine-tool deficiency was being overcome, it appeared that shortages of materials, and especially of aluminum, would succeed it as one of the major sources of difficulty. Although prewar plans for mobilization had included surveys of the existing and potential capacity of the aluminum industry, the Air Corps in 1940 lacked the data necessary for an accurate estimate of its future needs. Plans drafted during that summer depended chiefly upon figures supplied by the Aluminum Company of America, at that time the only producer of aluminum in the United States,* and estimates made in connection with the President's program for aircraft production proved subsequently to have been decidedly low.[35] Not only were the assumptions which shaped initial plans for expansion of the industry's capacity wrong, but the successive and drastic upward revision of goals for aircraft production tended to open new gaps between the demand

* The Reynolds Metals Company produced a substantial quantity of aluminum during the war, and Kaiser and Bohn were getting into production at the end of the war.

and the supply of aluminum. Even though the production of primary aluminum might be up to estimated requirements, the supply might not be sufficient in the shapes and forms—forgings, extrusions, and high-strength sheet—needed for the manufacture of planes. Aluminum shortages affected the production of several aircraft companies—among them North American, Martin, and Northrop—from the very outset of their expansion, and the Air Corps early in 1941 attributed delays in delivery of the B-17E, the B-24D, and the P-40D to shortages of aluminum alloy tubes and forgings.[36] Further trouble arose from the lack of adequate controls and from the consequent tendency of some manufacturers to hoard surpluses badly needed by other companies. Shipments of large stocks to Great Britain and to Russia also helped to keep the situation in the United States a tight one.

Although the government had sponsored a major expansion of aluminum capacity during 1941, including provision for fabricating facilities, and had arranged for large purchases from Canadian sources, the coming of the war and the greatly increased aircraft program announced by the President in January 1942 automatically rendered obsolete all existing plans. The President, even before the public announcement of the new objectives, had demanded attention to the need for expansion of aluminum production and for a substantial reduction of its use in the shipbuilding program. Late in January, Lovett felt impelled to protest vigorously the continued use of aluminum by the Navy for mobile kitchens, ship galleys, soda fountains, lockers, and similar items. If the established aircraft goals were to be met, he warned Hopkins, more than 80 per cent of aluminum production would be required and a strong system of priorities would have to be fixed in accordance with this fact.[37] But not until the second quarter of 1943, when the Controlled Materials Plan was adopted,* was the AAF satisfied with the provision for distribution of available stocks.

Meantime, the AAF became a spokesman for the aircraft manufacturers—who consistently attributed to shortages of materials, particularly aluminum, their failures to deliver the goods on time—and pressed on other government agencies the need for assistance. Lovett informed Hopkins in March 1942 that Ford could double its daily production of 2,000-horsepower motors if only it could get the necessary aluminum.[38] The seriousness with which the AAF itself viewed the

* This plan, by controlling the allocation of steel, copper, and aluminum, was successful in producing a smoother flow of raw materials throughout the munitions industry.

problem is indicated by its attempts to develop combat and transport aircraft models built of other materials (chiefly steel and wood), experiments that proved disappointing.* WPB officials tended to counter the complaints made by the manufacturers with charges of improper and untimely ordering by the aircraft companies, their failure to maintain proper controls of inventory, and continued hoarding. In short, the failure was one of management and not of supply. When Charles E. Wilson, as chairman of the Aircraft Production Board, made this view a specific charge in a communication to the President of March 1943, the AAF sharply disagreed, asserting that delays in aircraft production must be attributed chiefly to shortages in the supply of necessary materials.[39] The disagreement reflected something of the pressure under which all parties worked at this critical point in the productive effort, and of the circumstances which naturally made of the AAF an advocate of the manufacturers' point of view before those authorities who exercised ultimate control over the distribution of critically needed materials.

After the summer of 1943 the aluminum shortage effected a real limitation on aircraft production only in isolated instances. Not only did adoption of the Controlled Materials Plan result in a smoother and more equitable distribution of available stocks, but technical advances in the fabrication of aluminum helped eliminate the particular shortages of which there had been the most complaint. By the end of 1943 the supply and production of aluminum was so well in hand that the construction of three new extrusion plants was canceled.[40] During 1944, as the munitions program passed its peak, the manufacture of aluminum was curtailed for fear of overproduction, which threatened to reach large proportions. The failure to end the European war in 1944 and the sudden panic engendered by the German Ardennes offensive in December of that year caused the armed services to raise their munitions goals once again. The new demand for aluminum was also swelled by an earlier failure accurately to estimate the requirement for B-29 production. Requirements for sheet aluminum in the first quarter of 1945 jumped 50 per cent over the previous quarter.[41] In January 1945 the shortage of aluminum sheet and extrusions became severe enough to persuade the AAF in February to release 1,000 soldiers on 90-day emergency furloughs for work in the aluminum plant at Alcoa, Tennessee. Production increased during the first quarter, and during the second quarter Germany's collapse gave assurance

* Among them were the XP-57, P-66, YC-62, YC-76, and UC-78.

that stated requirements for most types of aluminum would not have to be met. A shortage of certain forms, particularly ingots, persisted, but the Japanese surrender soon brought upon the industry a surplus of both capacity and stocks.[42]

As the more pressing problems relating to shortages of machine tools and materials approached solution in the latter half of 1943, they were succeeded by a growing concern over a threatened labor shortage. It is debatable whether an over-all shortage of manpower existed in the aircraft industry at any time during the war, but the fear of it did exist after 1943 and from first to last a variety of difficulties involving the labor force on which the aircraft industry depended repeatedly required AAF attention.

The rapid expansion of the aircraft industry after 1939 produced a twenty fold increase in the labor force between January 1940 and December 1943, from perhaps 100,000 to almost 2,100,000.* Prime contractors in airframe, engine, and propeller plants employed more than 1,300,000 persons in December 1943, compared with something less than 80,000 in January 1940. After January 1944 there was a steady decline in employment to approximately 1,230,000 in July 1945, and a drastic cutback to 500,000 in August, the first postwar month.[43]

Because the rapid expansion of the aircraft industry was accompanied by a prompt shift to production techniques permitting the employment of unskilled or semiskilled workers, the industry suffered no serious problem in recruiting a labor force large enough for its needs. And since its expansion predated any comparable increase of the military forces, the inroads made on its labor force by calls to military service were less serious than with industries whose expansion came at a later stage in the war. As enlistment and conscription cut down the number of younger men available, it was possible to replace them by use of resources theretofore not fully exploited—notably women and Negroes. The location of so much of the new plant in interior areas remote from the more competitive labor markets provided another advantage, its benefit coming for the most part at the very time when a pinch in the labor supply might have been expected.† Anticipated shortages after 1943 proved to be nowhere near

* Including vendors and subcontractors.

† In June 1942 only 6 per cent of total employment in plants operated by prime contractors was located outside the two coastal areas. Two years later almost half of the total number of employees were working in plants situated in the interior of the country.

so serious as had been feared, partly because estimates of the need were considerably in excess of that which actually developed.[44] The great difficulty lay in the supply of skilled labor, which not even new techniques of production could do without and which, indeed, became all the more indispensable for supervision of the greatly increased force of unskilled labor.

As the demands of selective service began to drain the aircraft plants of an increasing number of trained technicians and supervisors, the AAF responded to bitter protests from the manufacturers by interceding with the Selective Service System to limit the drafting of key technicians, and the AAF was able to secure deferments for large numbers of such young men. On at least one occasion, in 1943, the AAF itself released men from active military service, transferred them to the Enlisted Reserve Corps, and placed them in Wright's Wood-Ridge engine plant for a period of six months, later extended to twelve.[45] The need to defer specially qualified personnel was all the greater because of the high rate of turnover among other aircraft employees. Although the turnover rate was lower than in most other munitions industries, aircraft manufacturers in 1941 had to hire 1,500 workers in order to increase employment by 1,000, and in 1942 they had to hire 2,100 workers to obtain an increase of 1,000. For the six-month period of December 1944 through May 1945, even though there was a reduction by 89,400 in the labor force needed by prime airplane contractors, these companies had to hire 200,000 workers. Under such circumstances, the importance of a trained nucleus of key technicians and supervisors becomes obvious, and the effort to secure military deferments for these men quite understandable.[46]

There were other problems which, taken together, were hardly less serious. Absentee rates of 6 to 8 per cent in 1943–44 had such serious consequences that the AAF conducted surveys of absenteeism for the purpose of helping the manufacturers reduce the excessive rate. The AAF also contributed materially to the settlement of labor disputes, frequently before they erupted into strikes. Where settlements could not be obtained and stoppage of production at key plants was threatened or had occurred, the AAF became the responsible agent for operation of such plants when taken over by the government, a responsibility which the AAF was generally reluctant to assume. In attempts to support the morale of aircraft workers, the AAF gave attention to provisions for good shop conditions in negotiating

contracts for plant expansion. It also tried to improve the worker's morale by stressing the vital significance of his task.[47]

The final measure of the utilization of manpower was in its productivity, and here, in spite of the declining quality of the worker, there was an impressive growth. The average accepted airframe weight per employee per month increased from 21 pounds in January 1941 to 49 pounds in March 1943 and to 96 pounds in May 1944. During 1941 part of the increase was the result of longer hours of work, but afterwards the figures represent an actual increase in hourly output. In 1944 the labor cost per pound of airframe was only about a third of the cost early in 1941, although earnings per hour had increased more than 50 per cent.[48]

One final difficulty, failure to provide adequately for spare parts, deserves special attention, and for this serious failure the AAF itself must shoulder the primary responsibility. Before 1939 it had been established practice to procure, concurrently with new planes, spare parts at a ratio ranging up to 25 per cent of the money value of the total number of planes. This figure, though representing the estimate of need under peacetime conditions, was larger than it might otherwise have been because limited appropriations for the Air Corps left it no choice but to keep its planes in active service over an extended period of time. During the war years, from 1 July 1940 to 31 August 1945, spare-parts production, measured by weight, equalled 14 per cent of airframe production. The number of engine and propeller spares came to 65 per cent of the total initially installed on AAF planes.[49]

In 1939 Arnold had gambled on the prospect that additional funds for the purchase of spare parts would come through promptly enough to permit him to use all currently available funds for the purchase of complete aircraft. White House pressure to procure the maximum number of planes was strong, so strong as perhaps to justify an assumption that once the government was committed to a program on the scale proposed, it would also readily provide the money for indispensable spares. Unfortunately, however, the necessary funds did not become available for more than a year, and it took much longer still to overcome the disruptive effect of this time lag. In May 1941 the 20th Pursuit Group reported an average of 30 per cent of its planes out of commission for lack of spare parts, a condition probably typical of most combat groups at that time.[50] By the summer of 1941 the

shortage of spares had become severe enough to force the Air Corps to use about one-fifth of its new plane deliveries to provide parts; thus "cannibalizing" some planes to keep others in operation received early official sanction. The shortage was felt more acutely by AAF units because first claim on available spares went to RAF units using U.S. planes in combat. Even so, the RAF in the Middle East encountered serious difficulties in the operation of its American-built planes because of an insufficient supply of spares. Reporting this condition to Arnold late in August 1941, AM Arthur T. Harris, then head of the RAF delegation in Washington, sympathetically recalled the RAF's own unhappy experience with the same problem that plagued Arnold. It, too, had yielded in 1938 to political pressure for the purchase of complete planes, and was still struggling to overcome the acute shortage of spare parts which resulted. Harris urged that the AAF give the most careful attention to the production of parts.[51] The question already had become the subject of anxious discussion in War Department circles, and on 2 September Arnold directed that spare parts be procured at the same time as complete aircraft in all current and future contracts. Spares for planes already in service were also to be procured as promptly as possible without disrupting the current production of aircraft.[52] Even at this late hour the pressure for aircraft production was apparently such as to argue against resort to a drastic solution.

That pressure had its effect also on the attitude of the manufacturers. Anxious to gain the advantage of a good record on the delivery of complete aircraft, they at times kept to schedule, or at any rate close to it, by neglecting the production of spares. Subsequent experience suggests, too, that the Air Corps, though alert enough to the need, tended before Pearl Harbor to underestimate the requirement and to make insufficient provision for spare parts.[53] After Pearl Harbor, the number of planes grounded for lack of spare parts reached an alarming rate. From theaters of combat, where damaged and even fully serviceable planes were cannibalized to provide spare parts and engines, came ever more insistent demands for help as combat damage and the backlog of unrepaired aircraft grew apace. During 1942 the demand became at times so great that engines were actually removed from aircraft in the United States for shipment overseas.

The AAF, in turn, put pressure on the manufacturers. Besides its policy of demanding delivery of spare parts concurrently with the

aircraft, the AAF now asked for an additional 10 per cent payment on the backlog of undelivered parts. When some manufacturers showed reluctance to accept these terms, the AAF insisted that all arrears be cleared up by the end of 1942. At midyear improvement was apparent, but the shortage of engine parts had become so critical as to lead to an order for delivery of these parts without regard to the effect upon the production of complete engines during the months of June and July. And more than once during that year the AAF indicated its willingness to accept delays in the production of finished aircraft in order to get spare parts which were in particularly critical supply.[54] Late in 1942 the AAF undertook to establish a policy of procuring spare engines at a rate of 100 per cent replacement for all combat and transport aircraft scheduled for use overseas, but the Joint Aircraft Committee, which recognized that this goal could be achieved only at too great a cost to the production of new aircraft, set the figure at 40 per cent.[55] The alternative left to the AAF was to make a more careful allocation and distribution of the engines which would be made available to it.

By early 1943 the Joint Aircraft Committee was urging strong measures to reduce the production of spare parts, and particularly of large airframe components which consumed such quantities of relatively scarce aluminum extrusions as to threaten delay in the accomplishment of over-all programs. But the AAF still occasionally found it necessary during 1943 to sacrifice complete plane and engine production to the manufacture of spare parts; in August, for example, the Materiel Command was ordered to curtail production of up to 200 B-24's in order to get spares for the planes already in service. AAF policy, as stated in October 1943, gave the same priority to planes and spare parts.[56] Because of frequent changes in models and variations in their rates of attrition, the determination of requirements for spares remained a difficulty even after war production had reached its peak. Shortages and surpluses occurred during 1944–45 in spite of frequent efforts to improve the whole procedure for procuring and distributing spare parts.[57]

The major share of the responsibility clearly falls on the AAF. Though the manufacturers, sometimes for reasons beyond their control, often failed to meet the AAF's orders for spare parts, the latter had not developed an effective system for calculating requirements and scheduling production in time to prevent the critical shortages

which marked the early years of combat operations. Not until 1943 would the time initially lost in the provision of parts be fully recovered.

The Measure of the Production Achievement

By 7 December 1941 the United States had become the foremost producer of military aircraft in the world. In less than two years the American aircraft industry had overtaken the other powers of the world in rate of production, despite the head start they all enjoyed and despite the export to later allies of production equipment and materials which conceivably could have been used for a still greater increase of American aircraft production. The achievement after 7 December 1941 was even more impressive. From an annual production rate of about 25,000 planes as of November 1941, American production reached a peak rate of almost 110,000 planes as of March 1944. The 9,113 planes turned out in that month came close to equalling the combined production for the same period of the other four major powers involved in the war. The comparative figures for the entire war are as follows:[58]

Year	*Japan*	*Germany*	*Great Britain*	*United States*
1939	4,467	8,295	7,940	2,141
1940	4,768	10,826	15,049	6,086
1941	5,088	11,776	20,094	19,433
1942	8,861	15,556	23,672	47,836
1943	16,693	25,527	26,263	85,898
1944	28,180	39,807	26,461	96,318
1945	8,263*	......	12,070†	46,001*

* Eight months only for U.S. and 7½ months for Japan.
† First three quarters only.

Official statistics of Russian aircraft production are not available. In a speech early in 1946 Stalin spoke of Russian production as having reached a rate of 40,000 planes per year during 1944.

If the more accurate index of airframe weight be used, U.S. production in all probability greatly exceeded the combined total for the rest of the world in 1944. The American industry produced 1,101,116,000 pounds, including spares; the British 208,520,000 pounds; and the German 174,939,000 pounds. Japanese production may be reliably estimated at a little better than 100,000,000 pounds. If one accepts a maximum figure of 200,000,000 pounds for Russia, based on Stalin's figure of 40,000 planes and on the assumption that these were the lighter type commonly employed by the Russians in tactical support

of their ground forces, the total for the four powers is under 700,000,000 pounds or less than two-thirds of the American production.[59]

These figures reflect significant differences in the aircraft programs of the several powers. In the United States after March 1944, although production declined as requirements were cut back, the average weight per unit continued to increase as a result of the emphasis placed upon the production of large planes for strategic bombardment or for ATC's world-wide system of air transport. Only the British figures offer a parallel with the steady rise in average unit airframe weight which characterized American production.* In Germany and Japan, neither of which had at any time gone in for heavy bomber production on the scale adopted by the British and the Americans,† there came with the receding tides of their military fortunes a growing emphasis on the smaller defensive type of plane. Single-engine fighters constituted 65 per cent of the total number of planes produced by Germany in 1944, a figure that compares with 24.2 per cent in 1941 and offers eloquent tribute to the increasing effectiveness of RAF and AAF bomber operations. Similarly, fighters accounted for almost 50 per cent of Japanese production in 1944, or two and a half times the 21 per cent of 1941. Although German and Japanese production increased significantly during 1943 and 1944, the increase in airframe weight was not in proportion to the increase in numbers. German aircraft production increased by about 65 per cent from 1942 to 1943 and just under 60 per cent from 1943 to 1944. But airframe weight for the same years increased only 48 per cent and 23 per cent. The average unit weight of German airframes decreased from 1941 to 1944, falling from some 7,000 pounds to little more than 4,000 pounds. Germany's total airframe production of almost 175 million pounds in 1944 was greatly exceeded by the total production of only four U.S. plants—92 million pounds by Ford at Willow Run, 70 million pounds by Boeing at Seattle, 67 million pounds by Consolidated Vultee at San Diego, and 55 million pounds by Douglas at Long Beach.[60]

* From the beginning of 1941 to the end of 1944, the average unit weight of American planes, excluding spares, rose from less than 3,500 to almost 11,000 pounds. Including spares, the figures are roughly 4,000 and 12,000. In Britain, which placed a comparable emphasis on bomber production but not transports, the approximate average in 1941 was 4,300 pounds, and in 1944, 8,000 pounds.

† Four-engine bombers never constituted more than 1.9 per cent of German production in any one year. In 1944 they comprised 17 per cent of American production.

Of the grand total of 299,293* planes produced in the United States between 1 July 1940 and 30 August 1945, the AAF had cognizance of 230,175, the Navy of 69,118.[61] These totals included the many aircraft accepted by the two services for transfer to our allies under lend-lease, of which the greater proportion were of Army type. The AAF figure includes approximately 43,000 lend-lease planes of which Great Britain and Russia received the lion's share—25,870 and 14,612 respectively.[62] Speaking in terms of numbers, planes of AAF cognizance represented roughly 70 per cent of total production, but because of the greater weight of Army types, the AAF's share comprised 82 per cent of the total airframe weight produced. In view of the fact that few heavy bombers were transferred under lend-lease, the percentage of production actually going to the use of the AAF was probably larger still. Of the 802,161 engines accepted during the period, the AAF received 653,647 (81 per cent) and the Navy 148,514.[63]

The total number of military and special purpose aircraft, by type, accepted by the military services in the period extending from 1 July 1940 through August 1945 is shown in the following table:[64]

Type	*1940*	*1941*	*1942*	*1943*	*1944*	*1945*	***Total***
Bomber	623	4,115	12,627	29,355	35,003	16,087	97,810
Fighter	1,162	4,416	10,769	23,988	38,873	20,742	99,950
Reconnaissance	63	727	1,468	734	259	667	3,918
Transport	164	532	1,984	7,012	9,834	4,403	23,929
Trainer	1,794	9,373	17,631	19,939	7,577	1,309	57,623
Communications	1	270	3,174	4,377	3,691	2,130	13,643
Special Purpose	0	0	183	493	1,081	663	2,420
	3,807	19,433	47,836	85,898	96,318	46,001	299,293

The growing preponderance of combat planes, especially bombers and fighters, over all others is even more clearly depicted by the accompanying table (p. 353) for the same period of acceptances listed in terms of airframe weight by thousands of pounds, including spare parts.[65] Bombers and fighters accounted for approximately 83 per cent of the total airframe weight produced during 1940–45, as compared with less than 67 per cent of the total number of planes. Bombers alone comprised more than 61 per cent of total airframe

* This figure includes 5,254 planes produced for the United States in Canadian plants and 2,420 special purpose (target) aircraft. In addition, the United States produced 15,793 gliders plus civilian planes as follows: 6,785 in 1940, 6,844 in 1941, and 985 in 1942.

weight although they constituted only 32 per cent of aircraft production by number. The importance of the bomber in the aircraft production scheme is further underlined by the fact that heavy bombers (B-29, B-24, B-17), which comprised less than 12 per cent of aircraft production by number, required more than 35 per cent of total airframe weight.[66] By contrast, training planes, which numbered 20 per cent of total production, made up only 5 per cent of the airframe weight produced.

Type	*1940*	*1941*	*1942*	*1943*	*1944*	*1945*	*Total*
Bomber	5,091	45,607	182,672	484,068	682,313	348,010	1,747,761
Fighter	3,793	18,732	58,146	145,593	258,377	139,048	623,689
Reconnaissance	122	2,068	5,737	4,678	1,380	3,391	17,376
Transport	1,205	3,780	19,969	63,313	129,709	82,344	300,320
Trainer	3,389	19,917	45,953	56,793	24,488	4,638	155,178
Communications	2	378	2,192	3,893	3,464	2,280	12,209
Special Purpose	0	0	119	449	1,385	612	2,565
	13,602	90,482	314,788	758,787	1,101,116	580,323	2,859,098

Acceptances of aircraft engines for the period covered by preceding tables were:[67]

1940	15,513	1943	227,116
1941	58,181	1944	256,912
1942	138,089	1945	106,350
		TOTAL	802,161

Combat engines (those with a displacement of more than 1,340 cubic inches) numbered 633,082, trainer engines (under 1,340 cubic inches), 168,178, and turbojet engines only 901. Production of engines for combat aircraft did not exceed those for trainers until 1942. In 1945 production of heavy combat engines, those over 1,600 horsepower, exceeded all others, reflecting the emphasis on bombers and more powerful fighters. After lagging behind in 1940–41 and constituting a bottleneck in the assembly of complete aircraft, the production of propellers between 1 July 1940 and 31 August 1945 rose to the grand total of 807,424. About 80 per cent of the propellers were hydraulic, and most of the remainder were electric.[68]

The eighteen combat models upon which the AAF and the Navy chiefly depended during the war accounted for more than 86 per cent of the 201,678 combat planes produced between July 1940 and August 1945. Acceptances by model were as shown in the table at the top of page 354.

AAF	
B-29	3,760
B-24	18,188
B-17	12,677
B-25	9,815
B-26	5,157
A-20	7,230
A-26	2,446
P-38	9,535
P-51	14,490
P-47	15,579
P-40	13,700
P-39	9,585
TOTAL	122,162

Navy	
SB 2C	6,130
SBD	5,320
TBM-TBF	9,812
F4U	11,236
FM, F4F	7,898
F6F	12,210
TOTAL	52,606

Production for each of the three chief transport models was:

C-54	1,089
C-46	3,144
C-47	10,245

The grand total of 23,929 transports represented less than 8 per cent of total aircraft production, but their airframe weight of 300,320,000 pounds was 10.5 per cent of the total.[70]

The established manufacturers of 1940 continued to dominate the industry throughout the war. The eleven leading companies delivered 229,554 planes (more than 70 per cent of all of the planes accepted between 1 July 1940 and 31 August 1945), with acceptances for each of them standing finally at the following figures:[71]

North American	41,188
Consolidated Vultee	30,903
Douglas	30,696
Curtiss	26,154
Lockheed	18,926
Boeing	18,381
Grumman	17,428
Republic	15,603
Bell	13,575
Martin	8,810
Chance Vought	7,890

Three other firms—Ford, Goodyear, and the Eastern Aircraft Division of General Motors—produced an additional 24,180 planes among them, distributed as follows: Eastern Aircraft (13,449), Ford (6,791), and Goodyear (3,940).[72] Acceptances by airframe weight, listed in thousands of pounds with spares excluded and for the calendar years 1940 through 1944,[73] change the order indicated in the preceding table, as shown in the table on page 355. Four companies, it will be noted, produced more than 50 per cent of the total airframe weight during 1940–44. North American, first in number of planes produced,

was fourth in airframe weight, a large proportion of its output having been trainers and fighters. The other three—Douglas, Consolidated Vultee, and Boeing—supplied the bulk of bombers and transports, with Douglas carrying the main load with the latter type. The greatest quantity of airframe poundage produced at one plant in any one year was at Ford's Willow Run factory in 1944—92,568,000 pounds. For the five-year period 1940–44, the Consolidated Vultee plant at San Diego produced 180,702,000 pounds of airframe weight, or 9.1 per cent of the total amount produced in the country.

Company	*Total*	*Per Cent of 5-Year Grand Total*
Douglas	306,573	15.3
Consolidated Vultee	291,073	14.6
Boeing	226,477	11.3
North American	210,913	10.5
Lockheed	180,118	9.0
Curtiss	136,091	6.9
Martin	126,970	6.3
Ford	123,076	6.2
Republic	75,893	3.9
Grumman	73,767	3.7
Bell	53,037	2.7
Eastern	47,869	2.4
Chance Vought	28,952	1.4
Goodyear	13,668	0.7
All other plants	101,136	5.1
Grand total—all plants	1,995,613	100.0

Pratt & Whitney and Wright maintained a traditional leadership in the field of engine production. As the table at the top of page 356 indicates, it was possible to meet demands for engines only by the aid of licensees drawn from the automotive firms.[74] These figures are particularly significant for the light they throw on the distinctive policies of the two leading producers. It will be recalled that Wright preferred to expand through the establishment of branch plants operated under its own control but Pratt & Whitney depended heavily upon licenses to other firms. It would appear that the latter's policy proved to be the more effective means of increasing production. Wright produced more engine horsepower from 1938 through 1941, but Pratt & Whitney and its licensees outproduced Wright by a substantial margin for the remainder of the war.[75]

In the propeller industry Curtiss-Wright and Hamilton Standard

*Engine Accceptance by Companies**

(1 July 1940–31 August 1945)

Wright and Licensees	Wright	136,494
	Studebaker	63,789
	Dodge	18,349
	TOTAL	218,632
Pratt & Whitney and Licensees	Pratt & Whitney	130,117
	Buick	74,198
	Chevrolet	60,766
	Ford	57,178
	Packard	54,714
	Nash-Kelvinator	17,012
	TOTAL	393,985
Independents	Allison	69,618
	Jacobs	32,119
	Continental Motors	28,824
	Lycoming	24,871
	Ranger	14,266
	TOTAL	169,698

* A number of smaller companies produced an additional 19,846 engines for a grand total of 802,161.

continued as the dominant manufacturers, although Nash-Kelvinator, one of Hamilton Standard's licensees, surpassed Curtiss-Wright's output for the period, as the following table of acceptances of hydraulic and electric propellers for the period 1 July 1940–31 August 1945 indicates:[76]

Hamilton Standard	233,021
Nash-Kelvinator	158,134
Curtiss-Wright	144,863
Frigidaire	76,626
Remington Rand	62,354
Aeroproducts	20,773

Most of the other manufacturers were also licensees of Hamilton Standard. As with engines, Curtiss-Wright preferred to expand its own capacity rather than license outside companies.

While over-all figures on production are both impressive and significant, they fail in themselves to lend proper emphasis to what was from the military point of view much more important—the accelerated

rate of production. It was not merely that the planes were produced in the quantities and types required, but that they were produced on the time schedules demanded by strategic plans. The following table of elapsed time between the initiation of design on twelve major combat planes and acceptance of the 500th article, a point at which quantity production must be presumed to be well under way, offers interesting evidence on the acceleration of production during the war years:[77]

	Start of Design	*Prototype First Flown*	*First Production Article*	*500th Acceptance*	*Approximate No. of Years*
B-17	Aug. 1934	1935	1939	Apr. 1942	$7\frac{3}{4}$
P-39	June 1936	Apr. 1939	Sept. 1940	Oct. 1941	$5\frac{1}{4}$
A-20*	1937	1938	....	May 1941	4
P-40	Mar. 1937	Oct. 1938	May 1940	Nov. 1940	$3\frac{1}{2}$
P-38	June 1937	1938	Sept. 1940	Apr. 1942	$4\frac{3}{4}$
B-25	Feb. 1938	Feb. 1941	Feb. 1941	Apr. 1942	$4\frac{1}{4}$
B-24	Sept. 1938	Dec. 1939	June 1941	June 1942	$3\frac{3}{4}$
B-26	June 1939	Nov. 1940	Feb. 1941	July 1942	3
P-51	May 1940	1940	Aug. 1941	May 1942	2
B-29	June 1940	Sept. 1942	July 1943	July 1944	4
P-47	July 1940	May 1941	Dec. 1941	Dec. 1942	$2\frac{1}{2}$
A-26	Jan. 1941	July 1942	Sept. 1943	Nov. 1944	$3\frac{3}{4}$

* The A-20 was originally the Douglas DB-7, and the first production article probably flew in 1938 or early 1939. It is likely that the 500th acceptance occurred before May 1941.

The average elapsed time is somewhat distorted by the $7\frac{3}{4}$ years attributed to the B-17, for this was a special case in which production was unduly delayed for other than technical reasons.* Not until June 1940 was a production contract let for more than 25 B-17's. Leaving the B-17 aside, the elapsed time for the six planes initiated prior to 1939 averages approximately $4\frac{1}{4}$ years from the start of design to the acceptance of the 500th plane; for the five planes designed after 1938 the rough figure is 3 years, or a gain of approximately 15 months. The difference reflects the influence of a multitude of complexly interrelated factors, but they may be summed up briefly and simply in this way: within the Air Corps and in the industry there came a shift from the more leisurely procedures of peacetime to the pace demanded by a state of emergency, and men acted with new assurance as to what would be expected of them and what could be attempted.

* See above, pp. 203–6.

If one speaks in terms of the percentage of increase of production, the critical years were 1941 and 1942. Tabulation of annual acceptances of military aircraft from 1940 through 1944 shows the following results:[78]

	Total Number	Per Cent of 5-Year Total	Per Cent of Increase over Preceding Year
1940	6,028	2.3	...
1941	19,433	7.6	222
1942	47,836	18.7	146
1943	85,898	33.6	80
1944	96,318	37.7	12
Grand total	255,513	99.9*	

* The remaining .1 per cent was distributed over the five-year period.

So much of the earliest production went into provision for the needs of the training program that one naturally turns to the record on combat planes. Acceptances restricted to that category still emphasize the importance of 1941 in the development of productive capacity, but a heavier emphasis falls upon the 1942 and 1943 increases than in the preceding table:[79]

	Total Number	Per Cent of 5-Year Total	Per Cent of Increase over Preceding Year
1940	2,986	1.8	...
1941	9,258	5.6	210
1942	24,864	15.0	169
1943	54,077	32.7	117
1944	74,135	44.8	37
Grand total	165,320	99.9	

A similar result is secured by tabulating acceptances in terms of airframe weight, spare parts included:[80]

	Total Poundage	Per Cent of 5-Year Total	Per Cent of Increase over Preceding Year
1940	24,600,000	1.1	...
1941	90,482,000	3.9	263
1942	314,788,000	13.8	247
1943	758,787,000	33.1	134
1944	1,101,116,000	48.1	45
Grand total	2,289,773,000	100.0	

And if the heavy bomber program (which to the AAF at least outranked all other programs in importance) be the test, 1942 becomes

decidedly the most significant single year in the production record. The following table measures percentages of increase both by number and by the airframe weight of the heavy bombers accepted:[81]

	Number	Per Cent of 5-Year Total	Per Cent Increase over Preceding Yr.	Airframe (Thousands of Pounds)	Per Cent of 5-Year Total	Per Cent Increase over Preceding Yr.
1940	61	.2	...	2,000	.2	...
1941	313	1.1	413	6,942	.9	247
1942	2,576	9.0	723	66,774	8.6	862
1943	9,485	33.3	268	257,336	33.0	285
1944	16,045	56.3	69	446,060	57.2	73
Grand total	28,480	99.9		779,112	99.9	

But percentages tell less than the actual figures on production listed in the tables above, which make it clear enough that it was in 1942 that the aircraft industry really got into production and that by the close of 1943 the problems of production had been so far whipped as to assure the overwhelming supremacy enjoyed by U.S. air arms in 1944 and 1945. That supremacy represented more than an industrial victory won on the home front; it bespoke the cumulative effects of many hard-won tactical victories on the battle fronts and the achievements of a training program no less impressive in its scale than was the production program, but under the conditions of modern war it is production that makes all else possible, and more especially production in time to count. By December 1941, the month of Pearl Harbor, the production of military aircraft had reached an annual rate of 29,000, which was impressive enough for a period when the problem had been not so much actual production as the creation of a production potential. By December 1942, when the Allied powers had only recently begun to seize the military initiative, U.S. plants were turning out planes at a rate of 65,000 per year. By December 1943, six months ahead of the invasion of Normandy, production had reached a rate of 105,000 planes per year. During the twelve months extending from September 1943 through August 1944 acceptances of military aircraft by the military services totaled 101,409 planes, the overwhelming percentage of them being combat models.[82]

The cost of the aircraft program for World War II has been estimated at approximately $45 billion. In terms of the most important

combat and transport aircraft models, the average unit cost* was as follows:[83]

Model	*1939–41*	*1942*	*1943*	*1944*	*1945*
B-17	$301,221	258,949	......	204,370	187,742
B-24	379,162	304,391	......	215,516	......
B-25	180,031	153,396	151,894	142,194	116,752
B-26	261,062	239,655	212,932	192,427	......
B-29	......	893,730	......	605,360	509,465
A-20	136,813	124,253	110,324	100,800	......
A-26	224,498	......	254,624	192,457	175,892
P-38	134,284	120,407	105,567	97,147	......
P-39	77,159	69,534	......	50,666	......
P-40	60,562	59,444	49,449	44,892	......
P-47	113,246	105,594	104,258	85,578	83,001
P-51	......	58,698	58,824	51,572	50,985
C-46	341,831	314,700	259,268	233,377	221,550
C-47	128,761	109,696	92,417	88,574	85,035
C-54	516,553	370,492	400,831	285,113	259,816

The great contrast between the cost of combat and noncombat aircraft† is revealed in the following table of costs of training and communications aircraft:[84]

Model	*1939–41*	*1942*	*1943*	*1944*	*1945*
PT-13 series	$10,002	9,896	......	......	......
PT-19 series	9,710	12,911	11,000	15,052	......
BT-13 series	25,035	23,068	......	......	......
AT-6	29,423	25,672	......	22,952	......
AT-7 series	76,827	85,688	68,441	......	......
L-4	......	2,432	2,437	2,620	2,701
L-5	......	10,165	......	9,704	8,323

The steady decrease in the cost of almost every type of plane was, of course, the result of volume production, and the decrease undoubtedly would have been greater had there been no changes in the various models between 1940 and 1945. But great changes did occur, and almost every model became larger and more complex as more armor, armament, communications equipment, and fuel tanks were in-

* The unit cost for the first year usually included the experimental and test models which were, of course, far more costly than the production models which followed, and therefore heavily weighted the unit cost for the initial year. The blank spaces in the chart above indicate that official figures are not available for those years.

† The unit cost of American aircraft was undoubtedly higher than foreign aircraft. In 1943, under reverse lend-lease, the cost of the British Spitfire, complete with all equipment, was $45,000, as compared with almost $63,000 for the P-39 and $58,000 for the P-51. It was believed that the difference was mainly in the labor cost.

stalled. Thus the AAF was receiving better planes for less money* in 1945 than it had received in 1940 or 1941, and this was accomplished in spite of the fact that many of the costs connected with aircraft production increased greatly during the period. Mass production reduced the man-hours required to manufacture a B-17 airframe from 54,800 in 1942 to 18,600 in 1944 and halved the construction time from the 400th to the 1,000th B-29, more than offsetting the increased cost of labor. By mid-1944 the labor cost per pound of airplane was only about a third of what it had been early in 1941, even though hourly earnings had risen by more than 50 per cent.[85]

* One reason was the constant supervision and renegotiation of contracts to protect the interests of the government.

CHAPTER 11

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THE AAF'S LOGISTICAL ORGANIZATION

IN ADDITION to determining the types and numbers of planes required for the fulfillment of its mission, the AAF had to develop an organization for logistical support of its combat forces. The term logistics has a variety of connotations. It could be interpreted so as to signify all the subjects included in this section of the narrative, but in this chapter the term will be used to denote only those services of supply and maintenance necessary for support of combat units. To provide these services on the scale required and within the time limits fixed by strategic schedules imposed upon the AAF one of its heaviest burdens. It was necessary to develop within the United States a vast organization for the procurement, storage, and distribution of an almost infinite number of both stock and special items of supply; to provide the means for channeling these supplies to widely scattered combat areas; and to organize, equip, and train a variety of service units for assignment overseas. The Army's Services of Supply could be counted upon for the provision of "common use" items–such things as uniforms and food–and the several technical services procured critical items of equipment and ordnance. But the supply of items peculiar to an air force was, in general, the responsibility of the AAF, which was also carrying the full responsibility for maintenance services.

Fortunately, the Air Corps did not have to start from scratch. The special characteristics of the airplane as a military weapon had from the first demanded somewhat unusual arrangements for its accommodation within the armed services. Adjustments to this necessity had never proceeded at the rate airmen felt desirable, but the Air Corps was the only component of the U.S. Army whose mission combined

both combat and logistical functions. Unlike their fellow officers in the Infantry or the Field Artillery, air officers had long been accustomed to control the procurement of their weapons and in large part to direct the logistical machinery on which the weapon's effective employment depended. The experience thus gained stood the AAF in good stead when it grappled with the problems of an enormous expansion.

Prewar organization had also already given to the Air Corps an essential prerequisite for its future autonomy. In 1939, and even in 1941, the hard-pressed leaders of the AAF had little inclination to assume the additional burdens that would have come with a transfer of responsibilities traditionally belonging to the Army's technical and supply services. But as the war progressed and the AAF's own organization matured, there naturally developed a growing inclination to free itself from dependence upon other organizations. By the war's end the AAF had gained a large share of the control over provision of the communications equipment, ordnance, and fuel used by its own forces; in other words, it had acquired significant responsibilities theretofore belonging to the technical services. In so doing, the AAF had also developed its autonomy at the expense of the Army Service Forces. Whatever else may be said of these developments, they unquestionably facilitated the postwar transition of the AAF to the status of a separate service.

The Air Service Command

From 1926 to 1942 the Materiel Division of the Office of the Chief of Air Corps (OCAC) was largely responsible for all operations of the AAF's logistical system. With headquarters at Wright Field and only a small liaison office in Washington, the Materiel Division through appropriate subsections administered the Air Corps' procurement and development programs, and through its Field Service Section (FSS) exercised ultimate responsibility for supply and maintenance within the Air Corps. The FSS controlled four major air depots located at San Antonio, Texas; Fairfield, Ohio; Middletown, Pennsylvania; and Sacramento, California.* The overseas air depots in Panama, Hawaii, and the Philippines came under the jurisdiction of the local departmental commands, with FSS acting only in an advisory capacity.[1] Direct control by the FSS thus extended only to the

* Before 1937 this depot had been at Coronado, California.

four continental air depots, which stocked and distributed Air Corps supplies and overhauled and repaired aircraft for operating units. The provision of immediate service and maintenance for combat units on Air Corps bases fell to military organizations normally under the direct control of the base commanders. These bases received their supplies from the Field Service depots and could look to those depots for assistance in maintenance.[2]

The division of function corresponded closely with and resulted from that separating the Air Corps and the GHQ Air Force. The Chief of the Air Corps had responsibility for production, procurement, storage, issue, and maintenance of all aeronautical equipment and supplies used by the Air Corps and not specifically required to be furnished by the Army's other supply services. The OCAC was also responsible for prescribing the rules and regulations governing procurement, production, storage, issue, test, maintenance, and techniques of operation relating to the equipment and supplies it furnished.[3] But the GHQ Air Force, since its organization in 1935, had enjoyed control over supply and maintenance services on its operating bases. Jealous of this control, GHQ Air Force resisted encroachments by OCAC agencies[4] and successfully restricted FSS to technical supervision of the work on combat bases. This supervisory right was in itself limited to the issuance of general instructions pertaining to procedures and methods, and to a right of inspection without command authority. The situation, in short, reflected the dualism running throughout Air Corps organization at that time.

In November 1940 FSS proposed that the jurisdiction of the Materiel Division be extended to include control of supply and maintenance on all GHQ Air Force bases and stations. Only first echelon services, those actually performed by constituent elements of the combat unit, would be exempt from this control. Supply channels had also been complicated by the necessity to go through the Army's corps areas, under which all Air Corps units operated, and it was now proposed that supplies be moved directly from the Field Service depots to stations, with the Air Corps organization exercising complete responsibility all the way down to the supply agencies on combat stations. A further proposal for centralization of responsibilities called for the assignment of representatives of the Army technical services to FSS in order to effect closer coordination in all matters involving the technical services.[5] This proposal, however, failed to carry.

In December 1940 the Plans Division of OCAC recommended establishment of a "Maintenance-Supply Command" that would be built around the core of the Field Service Section and would operate through four wings—one to be located in each of the proposed air districts that were to be established in the following January.* After further discussion during the winter, the Air Corps on 15 March 1941 activated a provisional Air Corps Maintenance Command which became permanent on 29 April with War Department approval of the plan. But the new Maintenance Command, whose establishment marked a significant step toward the separation of functions formerly belonging to the Materiel Division, had its jurisdiction limited, in compliance with GHQ Air Force's recommendation that, except for technical supervision, the command's responsibilities for supply and maintenance "stop at the boundary of the Air base."[6] With headquarters at Wright Field, the Air Corps Maintenance Command included the old Field Service Section, the 50th Transport Wing, and six depots—the four at Fairfield, Middletown, San Antonio, and Sacramento; and two new ones at Mobile, Alabama, and Ogden, Utah. In July four maintenance wings were organized in the interest of a greater decentralization of operations.[7] On Air Corps stations, as distinct from those belonging to GHQ Air Force, the command proceeded to establish subdepots equipped to handle third echelon supply and maintenance.† The establishment of the Army Air Forces on 20 June 1941 and exemption of all Air Corps installations from corps area control on 1 July greatly aided the command in this development. But the Air Force Combat Command, which replaced GHQ Air Force under the new organization, refused to agree to proposals for establishment on its bases of subdepots under control of the Maintenance Command, and that command, in turn, refused to accept the principle that all service organizations on AFCC bases must be responsible ultimately to the Combat Command.[8]

The fact that Arnold as Chief of the AAF after 20 June 1941 had jurisdiction over both the Air Corps and the Air Force Combat Command provided the authority to resolve this difference of opinion. Plans soon took shape for a redesignation of the Maintenance Command as the Air Service Command, with an enlarged jurisdiction reaching into AFCC bases. General Emmons, as commander of the

* See above, pp. 18–19.

† For official definition of the several echelons, see below, pp. 384*n*, 388*n*.

AFCC, countered with recommendations which would have given the AFCC an even greater degree of logistical autonomy than it already enjoyed.[9] But when on 17 October 1941 the AAF established the Air Service Command as successor to the Maintenance Command, it conceded to AFCC views only to the extent of a provision leaving primary administrative responsibilities for subdepots to the station commander. Otherwise, the chief of the ASC, Brig. Gen. Henry J. F. Miller, was charged with supervision in the United States of all AAF activities pertaining to storage and issue of supplies procured by the Air Corps and with overhaul, repair, maintenance, and salvage of all Air Corps equipment and supplies beyond the limits of the first two echelons of maintenance. The command was directed to compile AAF requirements for Air Corps and other supplies, to procure equipment and supplies needed for the operation and maintenance of AAF units, to prepare and issue all technical orders and instructions regarding Air Corps materiel, and to exercise technical control* over air depots outside of the continental limits of the United States. In addition, ASC received responsibility for coordination with the Army technical services in the supply and maintenance of equipment and supplies procured by them for the use of the AAF. The new command was separated from the Materiel Division but remained a part of the OCAC.[10]

Between October 1941 and March 1942 the Air Service Command remained under the jurisdiction of the Chief of the Air Corps. Immediately after the beginning of the war it moved its headquarters to Washington, where it began operations on 15 December 1941.† But a large portion of the headquarters organization remained at Wright Field, where it carried on the greater part of the command's activities.[11]

The elevation of the Army Air Forces on 9 March 1942 to the status of one of the three major coordinate elements of the Army opened the way to solution of other problems lingering on as a result of the earlier organization. Both the OCAC and the AFCC were dissolved and AAF Headquarters took control of the forces previously assigned to them.[12] The Air Service Command now became one of the major AAF commands, with relatively clear lines of responsibility

* A loosely defined term used to indicate a right to issue instructions on technical questions relating to service activities.

† On 15 December 1942 its headquarters moved back to Dayton, establishing itself at Patterson Field, immediately adjacent to Wright Field.

and authority. Four air service area commands, successors to the maintenance wings, had been activated in December 1941 to supervise the depots in given geographical areas. The depots, of which there were eleven by April 1942, became the centers of depot control areas, which directed the activities of subdepots within defined geographical limits. Unfortunately, the boundaries of some of the depot control areas overlapped those of air service areas, and since the depots were the real focal points of supply and maintenance activities, the air service areas never attained the status of fully functioning ASC subcommands. The air service areas were disbanded on 1 February 1943, to be succeeded by air depot control area commands, which were simply the eleven former depot control areas under a new name. The elimination of the four air service areas was apparently justified by subsequent operations; according to Maj. Gen. Walter H. Frank, commander of the ASC, the step proved "most beneficial." In May 1943 the air depot control area commands were redesignated air service commands with appropriate geographical designations, and from then to the end of the war the ASC conducted its operations in the continental United States through its eleven air service commands,* each serving a separate geographical area.[13]

These air service commands directed the operations of a variety of installations and units of which the subdepots were the most important from the viewpoint of the combat and training units. At existing Air Corps bases in 1941 the materiel sections (engineering and supply departments) had been redesignated subdepots and cadres were trained to staff the many new bases being built; after January 1942 the Air Service Command extended the subdepot system to AFCC bases. These subdepots were charged with responsibility for third echelon maintenance of Air Corps equipment and procurement, storage, and issue of all types of Air Corps supplies, including fuel and oil. In the performance of these functions, the subdepots came directly under the control of the depots and were therefore in a chain of command headed by ASC. Despite ASC's effort during 1942 to extend its control over administrative and housekeeping functions for units assigned to the subdepots, these responsibilities remained with the base commanders.[14] The total number of subdepots in operation had reached 47 by the time of Pearl Harbor and 130 by September 1942; the peak number of 238 was reached at the beginning of 1944. In general, it

* In 1944 they were redesignated air technical service commands.

was the policy to man the subdepots with civilians, the number of employees per subdepot ranging from 100 to 800; however, at certain isolated bases where it was found impossible to recruit civilian labor in sufficient number the ASC stationed its own service squadrons.[15]

On 1 January 1944, in compliance with a decision of AAF Headquarters, the Air Service Command transferred the subdepots to the control of the commands or air forces on whose bases they were stationed. The basic reason for the transfer was apparently the desire at almost all levels of the combat echelon that the flying-unit commander have control of all of the services available on the air base, and AAF Headquarters supported this stand. Certainly there had been difficulties, probably inevitable under the circumstances, between subdepots and base commanders, and in such struggles for control of functions and units the combat echelon generally won out over the logistical one. The ASC retained responsibility for establishing engineering standards for the subdepots through publication of technical orders and instructions and for conducting quarterly inspections of the maintenance and supply activities of the subdepots. The loss of control of the third echelon supply and maintenance function on the bases left the ASC with the fourth echelon functions performed by its depots. One informed judgment held that while the transfer of the subdepots may have been desirable or necessary from the standpoint of administration of the individual air base, it may well have been undesirable for efficiency of the subdepot system as a whole.[16]

In addition to operating the depots and subdepots within the continental United States, the ASC was responsible for the shipment of Air Corps supplies and equipment to overseas theaters of operations. The channels of supply to overseas air forces depended chiefly upon two major ports of embarkation, New York and San Francisco, where the Transportation Corps of the Army provided the necessary port authority headed by a port commander. Because of the specialized nature of its equipment (and a constant readiness to assert its autonomy at every opportunity), the AAF found it desirable to set up special organizations for handling AAF equipment and supplies passing through the ports. During most of 1942, AAF activities at the ports were carried on by port air officers who were responsible to ASC as well as to the port commander. In November 1942 the ASC unofficially organized the New York Air Service Port Area Command which took over most of the port air officer's responsibilities,

except those pertaining to shipment of troops and their accompanying equipment.[17]

The growing importance of supplying the overseas air forces and the need for more efficient control of supply shipments led to the activation on 1 October 1943 of the Atlantic and the Pacific Overseas Air Service Commands, with headquarters at Newark, New Jersey, and Oakland, California, respectively. The Atlantic Overseas Air Service Command, successor to the New York Air Service Port Area Command, exercised control over the movement of Air Corps cargo through the ports of embarkation on the Atlantic and Gulf coasts. The Pacific Overseas Air Service Command performed the same function on the Pacific coast. The new commands also assumed control of the huge intransit depots previously established under the regional air service commands for receipt and distribution of supplies destined for overseas shipment. In addition to planning, booking, and delivering cargo to the ports, the two commands were soon authorized to initiate action on overseas requests and to direct action on certain special supply projects.[18]

The service units which supported the combat groups in overseas theaters of operations constituted the final links in the organizational chain of the AAF logistical system. Although ASC did not control, except through technical instructions, the overseas operations of service and air depot groups, it was responsible for organizing and training them for assignment to the overseas air forces.

Before 1941 the combat groups of the GHQ Air Force had operated from permanent bases with fixed service installations. Although there had been discussion of the probable need for mobile service units to accompany combat units into the field in the event of war, little had been done to create such organizations. The great expansion of the air arm and the imminence of war during the months before Pearl Harbor lent real urgency to the search for units suited to the need. After considerable experimentation during 1941 and early 1942, the service group and the air depot group emerged as the two basic field logistical units. The service group had its antecedent in the air base group which since 1941 had been performing supply and maintenance functions on combat bases, but it was better organized and more mobile than its predecessor. Its function was to provide third echelon supply and maintenance for combat units in the field, and, in practice, it generally shared the same base with the unit or units it

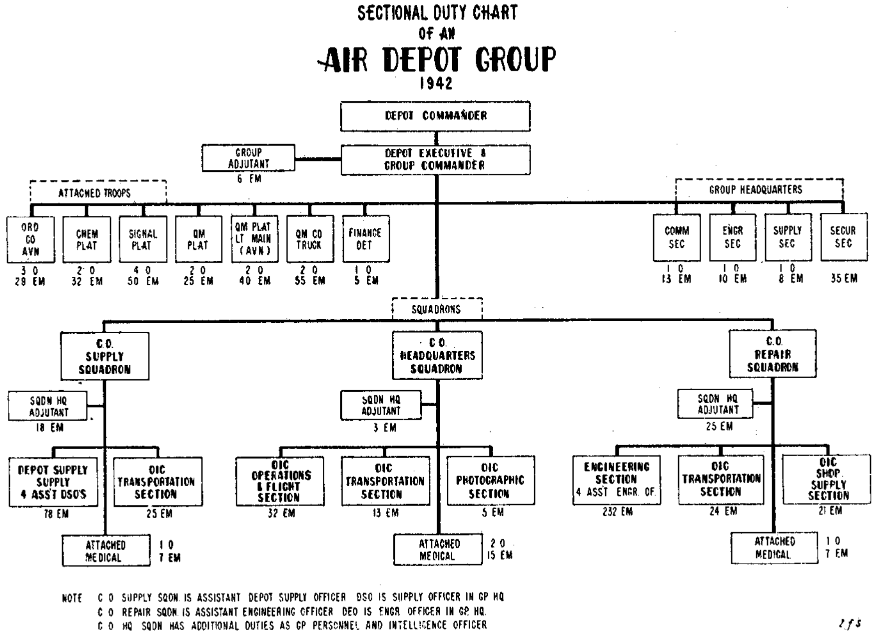
served. The air depot group, originally organized in 1941 to provide both third and fourth echelon services, was reorganized to provide only fourth echelon supply and maintenance in overseas theaters. The air depot groups were much less mobile than the service groups because of the heavy maintenance machinery and the large stocks of supplies upon which their operations necessarily depended.[19] The Air Service Command controlled the training of air depot groups from their beginnings in 1941, and assumed direction of the training of service groups in June 1942.*

The organization of these units emphasized the dual character of the function to be performed. According to T/O's issued in the summer of 1942, the air depot group was built around a supply squadron and a repair squadron. There were, in addition, a headquarters squadron and a variety of attached personnel or units from other arms and services, among them Ordnance, Chemical Warfare, Signal, Quartermaster, Finance, and Medical. To indicate the structure of the group, a sectional duty chart taken from the Air Service Command manual of 15 July 1942 is reproduced on page 371. The service group, with a total strength of more than a thousand men, was made up of two service squadrons and attached units. Though functional divisions of assignments within the squadron lent emphasis either to supply or repair work, the squadron itself was manned and equipped for the rendering of both types of service.

Although the ASC did not have control of overseas logistical operations, it sought to prescribe the necessary organization in overseas theaters. It was assumed that each air force would have its own air service command, and AAF Regulation 65-1, issued on 14 August 1942, outlined the organization of a typical overseas air service command. Such a command would control third and fourth echelon supply and maintenance. The air depot groups under it would handle fourth echelon services, generally manning base depots in the port areas and advanced depots situated closer to the bases of combat operation. The service group usually would operate a service center in the immediate neighborhood of combat bases and was organized with a view to providing services for two combat groups. Where feasible and more efficient, the service group might be placed on the same station with the combat group or groups it served. In actual practice, most of the overseas air forces deviated considerably from

* On training, see below, pp. 667–72.

this proposed organization. Many of them did not see fit to entrust their air service commands with control of the third echelon services, particularly when, as was often the case, the service unit was stationed on the same base with the combat group. They preferred to retain unity of command on the air base, adhering to the same principle which was responsible for the Air Service Command's losing control of subdepots on continental United States bases at the beginning



of 1944. Consequently, most overseas air service commands were concerned primarily with fourth echelon services, although they generally had some form of technical control over units providing third echelon services.[20]

The desired mobility was attained reasonably well in the third echelon operations of the overseas tactical air forces. The strategic air forces (Eighth, Fifteenth, and Twentieth), however, did not require mobile service units because the heavy bombardment groups normally operated from fixed bases that usually remained unchanged for the duration of the war.* Fourth echelon services never attained

* The bombardment groups of the Fifteenth Air Force stayed put once they established themselves in the Foggia region in Italy in 1943–44.

the mobility that had been hoped for, and throughout the world the air depot group tended to be anchored to the same place for much longer periods than were the service groups. As the air forces in Europe and the Pacific moved forward with the ground armies, the base depots and other installations operated by the air depot groups found themselves at increasingly greater distances from the units they were supposed to serve. The movement of an air depot group generally presented a major transportation problem because of its enormous impedimenta of machinery and supplies. Efforts to make the depot groups more mobile were not particularly successful because the efficient performance of their mission required them to be heavily encumbered.[21]

Besides struggling with problems affecting the organization and training of service units for overseas assignment, ASC experienced difficulty in attaining a workable division of responsibilities with its parent body. In the general reorganization of March 1942 the Materiel Division had been reconstituted as the Materiel Command, with a jurisdiction incorporating the functions left to the Materiel Division after the establishment of ASC. In general, the line dividing the two commands was clear enough: Materiel Command was the principal procurement agency of the AAF, with a consequent control over research and development; ASC was charged primarily with the distribution of equipment and supplies and with the provision of maintenance services. But there were difficulties. As a new command, ASC required time to develop the degree of self-sufficiency that was necessary for independence of its parent organization.[22] Moreover, a certain overlapping of function was virtually unavoidable; however logical the line of demarcation, it was difficult to make the line precise. Although the Materiel Command remained the AAF's chief procurement agency, the ASC had been given a limited authority for procurement, with some resultant confusion and disagreement. At the same time, the operation of the Defense Aid Organization, which procured, stored, issued, and transported supplies and equipment for beneficiary foreign governments, remained under the Materiel Command. The transfer of the Defense Aid Organization to ASC in May 1942 facilitated the handling of all distribution through one supply system.[23] But a divided responsibility for determination of requirements continued to demand a closer coordination and agreement between the two commands than was always possible. The Materiel

Command had the initial responsibility for purchase of airplanes and the equipment originally installed in them, while the ASC had the authority for the purchase of standard organizational equipment. The possibilities for overlapping jurisdiction in this field were manifold, and the disagreements between the two commands not infrequent. On occasion the Materiel Command would develop items of equipment which ASC would refuse to order because it was not convinced of their superiority over existing models. On the other hand, the Materiel Command would control the flow of spares to the ASC by fixing production schedules which did not always meet with the latter's approval. Other areas of overlapping and conflicting jurisdiction included engineering, packaging, salvage, the preparation and dispatch of shipping instructions to manufacturers, procurement of technical information from contractors, handling of unsatisfactory reports on equipment, standardization of equipment, disposal of excess property, and conservation of materials.[24]

As early as the summer of 1942 suggestions were made that the two commands would have to be united, and some argued that the newly established Air Transport Command (ATC)* should be included in such a merger for the sake of a truly integrated logistical organization. Arnold himself was interested enough in March 1943 to ask for a study of the desirability of placing the three commands "under one head," but no action ensued and the idea of an AAF Services of Supply that would include all logistical agencies was dropped.[25] By June 1944, however, AAF Headquarters had decided to combine the Materiel Command and the Air Service Command, a consolidation effected on 1 September 1944 with the activation of the Air Technical Service Command (ATSC) under Lt. Gen. William S. Knudsen. The actual consolidation of the two commands proceeded slowly in order to avoid severe dislocations which might impede the war effort. At AAF Headquarters the Assistant Chief of Air Staff for Materiel and Services, General Echols, retained responsibility for establishing AAF materiel and supply policies and for supervising the execution of such policies.[26] Thus in a period of less than three years, the organization of the AAF logistical function had come full circle—from unity to separation and back—except that the air transport responsibility re-

* The ASC had had the 50th Transport Wing for the transportation of freight and personnel. For a few months in the spring of 1942 it appeared that the ASC would be given all air transport and ferrying functions, but in June 1942 the Air Transport Command was charged with this important mission (see Vol. I, 359–62).

mained with the ATC and the staff and command principle was more clearly established in the ATSC than it had been with the Materiel Division.

The relationship between the AAF and the ASF also had a profound effect on the development of air service organization and operations. The special position accorded the AAF within the War Department included responsibility for procurement of all equipment "peculiar to the Army Air Forces" and command of AAF stations not assigned to defense commands or theaters. The establishment of the Army Service Forces as the over-all logistical agency of the War Department inevitably set the stage for disputes between the two commands. The powerful drive of the AAF for greater autonomy and the almost equally strong urge of the ASF for a greater degree of control of Army-wide logistics contributed much to the creation and broadening of differences which marred, but did not seriously hamper, an otherwise successful collaboration of the two commands.[27]

The chief differences between the AAF and the ASF centered about procurement for and administration of the AAF's bases. On policy affecting contracts, prices, and manpower, the AAF generally was willing to accept guidance from the ASF when acting in the name of the Under Secretary of War. But the AAF insisted on determining its own supply requirements and directing production of the materiel it ordered. It sought also to acquire procurement authority over a wider range of materiel, including many of the specialized items purchased for it by the technical services under the ASF. AAF proposals to take over procurement of guns and ammunition from the Ordnance Department were rejected, but success attended the AAF's attempts to relieve the Corps of Engineers and the Transportation Corps of authority for procurement of certain items of equipment. The most significant advance in procurement authority occurred in the fall of 1944 when the Chief of Staff directed that the AAF divest the Signal Corps of its responsibility for development, purchase, and storage of all communications and radar equipment used in aircraft. The procurement program thus transferred had an average value of one billion dollars per year during the war. The transfer, completed in the spring of 1945, involved some 9,000 military and civilian personnel, as well as a number of installations.[28]

The trend toward greater logistical autonomy was extended to the air bases, where the AAF whittled away the prerogatives originally

granted to the ASF. According to regulations adopted in 1942, the ASF had responsibility for a number of air base functions ranging from general courts-martial to operation of laundries. The AAF had refused in the summer of 1942 to permit its own Air Service Command to handle administrative and housekeeping activities on AAF bases; it was, of course, even less disposed to permit the ASF any considerable measure of control at the air base level and resisted what it regarded as encroachments. During the course of the war the AAF secured War Department approval for relieving the ASF of the supervisory responsibility for many of the functions performed on the air bases, including signal communications, ordnance maintenance, repairs and utilities, operation of laundries, salvage activities, and special services. The AAF also acquired supervisory responsibility for the establishment of stock levels of common use items* at air bases.[29]

The AAF also sought to secure complete control of its attached ASF units, which performed vital services for the air forces everywhere. The troops in these units, known as Arms and Services with the AAF (ASWAAF), represented almost every one of the Army administrative and technical services—Ordnance, Engineer, Signal, Quartermaster, Medical, Chemical Warfare, Chaplain, Adjutant General, Finance, Military Police. These troops averaged between 20 and 25 per cent of the total strength of the AAF during most of the war, reaching a peak of more than 600,000 in the fall of 1943. Trained by the ASF and attached to the AAF for duty, they retained their identity as members of their own arm or service. The War Department approved the integration of most of these troops into the AAF in the fall of 1943, but the actual process was so long drawn out that it had not been fully completed at the end of the war.[30]

Although the AAF did not completely succeed in throwing off ASF supervision of its logistical activities, it had gone a long way toward that goal by the end of the war. Confident that it was destined to become a separate military service in the postwar period, the AAF made its organizational changes and arrangements with the future in mind. These arrangements were not always compatible with maximum operational efficiency, but it would be difficult to show that they seriously interfered with the prosecution of the war. In the Air Technical Service Command the AAF had developed a solid logistical foundation on which to erect a separate air force.

* See below, p. 376.

Supply

The AAF supply system stretched from the factories in the United States to air bases in China, New Guinea, North Africa, Italy, England—to every corner of the globe where the AAF operated airplanes. The stock in trade of this system consisted of Air Corps and common use items of materiel. Air Corps supply handled items peculiar to that service—aircraft and related equipment—procured directly from the factory. Common use items were those which were in general use by all elements of the Army—food, clothing, ammunition, oil and gasoline, most communications equipment, etc. These items were procured for the AAF by the technical services of the Army and entered the AAF pipeline through Army Service Forces channels, either in the United States or overseas.

Within the United States, the Air Service Command computed the requirements for AAF materiel and, together with the Materiel Command, procured the various items. ASC storage depots received a constant stream of materiel from the factories and channeled it to operating forces at home and abroad. From storage depots, or direct from the factory, supplies were moved to control area depots and thence to subdepots for distribution to flying units on air bases in the United States; materials intended for overseas consumption moved from storage or area depots to intransit depots located near the major ports for water shipment overseas. Overseas the air service commands received the shipments for distribution to individual AAF organizations.

The initial problem in the operation of any supply system is to fix requirements. A requirement was defined in an official document late in the war, "as the quantity of a particular item or designated group of items needed for a specified military force during a stated period."[31] Requirements for aircraft were determined at AAF Headquarters in accordance with programs established at higher levels of authority, but the ASC had responsibility for determining the requirements for a myriad of other items needed by the AAF and for procuring them or requesting procurement by the Materiel Command or the ASF. In 1940 there were perhaps ten people in the Field Service Section of the Materiel Division engaged in the computation of requirements of spare parts for the Air Corps. By 1945 the work required the services of a large segment of the ATSC headquarters staff.

If measured against an ideal standard, which must be recognized as

impossible of attainment, the setting of requirements at the ASC level left much to be desired. Frequent and chronic shortages during the first two years of the war—the result partly of demands greater than had been anticipated when requirements were drawn up before the war—encouraged the responsible staffs to follow the safe, even though it might be a wasteful, policy. Money was plentiful and time was short; the natural inclination was to buy and thus to avoid the risk of further shortages. The situation during these earlier years offered, of course, much justification for the practice, and it should be noted that repeated changes in the over-all programs which formed the bases for computing subsidiary requirements made exact estimates the more difficult to achieve. But it cannot be said that the habits and attitudes shaped by the conditions of the earlier war years had been corrected by the end of the war.[32] Certainly the war ended with large surpluses on hand, much larger probably than were justified.

The Air Service Command had responsibility for the maintenance of stock records and for the collection and analysis of consumption data. Because they were of fundamental significance for the operation of the whole supply system, the successful performance of these two functions was of vital concern to the ASC and, indeed, to the whole AAF. Up to 1940 the Air Corps had maintained a stock-record system which had provided sufficient information for the computation of spare parts and other requirements. In an era when procurement was measured by the needs of scores of planes instead of thousands, and when there was no complicating factor like a war to cause fluctuations in consumption rates, it was no great feat to keep accurate records of stockage and consumption. The job was burdensome because of the handful of people assigned to the work, but the scope of the problem was well within their competence. The vast expansion launched in 1940 had as profound an effect on the AAF stock-record-keeping system as it had on almost any other AAF activity. The great increase in the number of planes, the multiplication of types and models, and the constant modifications of models eventually made it impossible for responsible agencies to keep records of sufficient accuracy or adequacy to be used extensively in the calculation of requirements. Statements of requirements for spare parts during 1942 and 1943, when the greater part of the procurement orders were placed, were based on "educated guesses" rather than on any real knowledge of consumption rates or stocks on hand.[33]

By 1942 the flow of supplies into the depots reached a rate beyond the capacity of existing facilities to handle it properly. Most of the depots were new or even still under construction, and their staffs were as yet inexperienced and imperfectly trained. Immediately after Pearl Harbor some depots, like that at Ogden, were inundated by massive stocks removed from coastal locations considered vulnerable to enemy attack. It proved impossible to inventory and bin such stocks because of lack of staff and storage space. Boxes and crates were dumped on the ground in the open, and no one at the depots knew the contents of the containers which covered hundreds of thousands of square feet. Consequently, these stocks were, in effect, unavailable and the ASC procured additional quantities of many items which it really had in stock but had lost track of. Not until 1943 did the ASC depots find the time for a comprehensive inventory of stocks—a task which required many months to complete.[34]

The number of AAF stock items mounted steadily from approximately 80,000 in 1940 to more than 500,000 in 1944. Records could not keep up with the phenomenal growth of the inventory or the rapid changes which occurred. The ASC made valiant efforts to keep stock-consumption records both by hand and by machine, but the records continued to be inaccurate or too outdated to serve as an accurate base for computation of requirements. From the overseas theaters there were virtually no valid consumption data available during 1942 and 1943, for the then fluid state of the combat areas did not permit the establishment of an effective reporting system. There was an increased flow of consumption data from overseas during 1944–45, but it was not enough to present the comprehensive picture required by ASC.[35]

Other deficiencies in the reporting system seriously affected the accurate calculation of requirements. The AAF possessed large quantities of repairable materiel items, but the pressures on maintenance organizations were such as to make it difficult for ASC to get accurate evidence on the prospective flow of repair work. The result was inadequate consideration of this factor in the computation of requirements and a further distortion of the over-all situation. Another major difficulty was the lack of uniformity in identifying items. This led to the stocking of identical items in many different ways under a variety of parts numbers. Contractors frequently changed the numbers of their parts at will, with the result that some parts had three or

four different numbers, some numbers were assigned to two or more different parts, and thousands of items had no identifiable parts numbers at all. Not until 1945 did the AAF make real progress toward establishing a uniform and accurate method of numbering spare parts.[36]

The leveling off of production and of AAF strength at approximately the same time in 1944 afforded the ASC an opportunity to refine its computation techniques. Substantial progress in this direction was made during 1944–45, and by the end of the war the ASC was on its way toward creation of procedures which promised to provide more accurate and comprehensive data for the calculation of requirements.

Although the computation of requirements was an important and vital function of the Air Service Command, its more pressing job was distribution. In peacetime the Air Corps had needed no complex machinery for the performance of this task. Acting on its own estimate of requirements, the Materiel Division ordered the needed supplies, usually in quantities covering the requirements for a period of one year, from manufacturers or other sources; deliveries were made to the four area depots, which in turn distributed the supplies to Air Corps stations. Sometimes the manufacturer shipped direct to the station and, under certain conditions, local purchase of some items was authorized.[37] The system met the prewar need well enough, but it could not be expected to be adequate after 1941. Between 1939 and 1945 AAF personnel increased 100 fold, and aircraft almost 40 fold. The supply system had to keep pace with demands which grew larger by the day and eventually flowed in from all parts of the world.

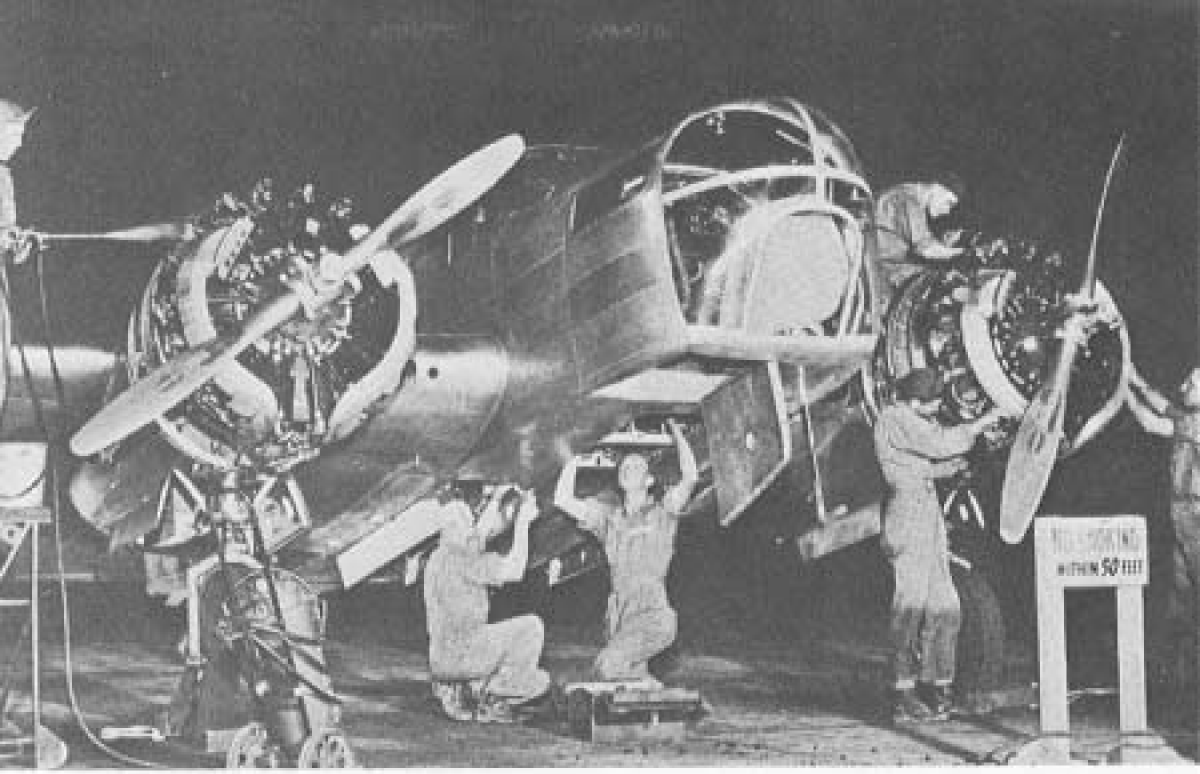
Beginning in 1940, the four original depots were greatly expanded, and the total number of such area depots had been increased to eleven by the end of 1942.* Even so the addition of space failed to keep up with the need. Between January and December 1942, for example, warehouse space at the San Antonio Air Depot increased 500 per cent, but receipts had exceeded shipments by approximately one-third and still more space was required. Extraordinary measures, including the leasing of warehouses as much as sixteen miles from depots, helped to ease the problem somewhat but offered no full solu-

* The seven new air depots were Ogden, Utah; Warner Robins (Macon), Ga.; Mobile, Ala.; Oklahoma City, Okla.; Rome, N.Y.; Spokane, Wash.; and San Bernardino, Calif. A depot was also opened at Miami, Fla., in 1943 but it never became a control area depot.

tion.[38] The inability of the area depots to handle the mountainous stocks of materiel which by the spring of 1942 were pouring from the factories, and the consequent piling up of airframe and engine parts in the manufacturing plants, spurred ASC to establish storage depots near the larger factories. These depots were to serve the area depots, storing large bulky supplies and issuing them as directed by the latter. By the summer of 1943 about forty storage depots were in operation; others had had a temporary existence. To obtain them, the AAF bought, built, or leased a variety of structures, the leases including a number of state fair grounds. In taking over responsibility for distribution of defense aid equipment, ASC acquired control over the operation of additional depots—twelve all told—which assembled, stored, and shipped lend-lease materiel to the ports. There were thirteen intransit depots by November 1943 for the handling of supplies en route to the overseas air forces. Government-furnished equipment (GFE) depots were established by the Materiel Command early in 1942 under the administration of its procurement districts. The eight GFE depots, which received, stored, and distributed GFE to aircraft manufacturers, were incorporated into the over-all ATSC depot system in 1944.[39]

By the end of 1942 the ASC depot system, including the subdepots on the stations, used a total of more than 20,000,000 square feet of storage space. Estimated needs by 1 August 1943 were fixed at 52,000,000 square feet. By August 1944 the total had reached some 62,000,000 square feet, not counting the subdepots, which had an additional 8,000,000 square feet of space. Two-thirds of the ASC-controlled storage space was government-owned and the remainder leased. During 1944 the cutting of authorized supply levels and the decreased demands from units and stations in the United States so eased the storage problem that some of the space previously acquired could be released.[40]

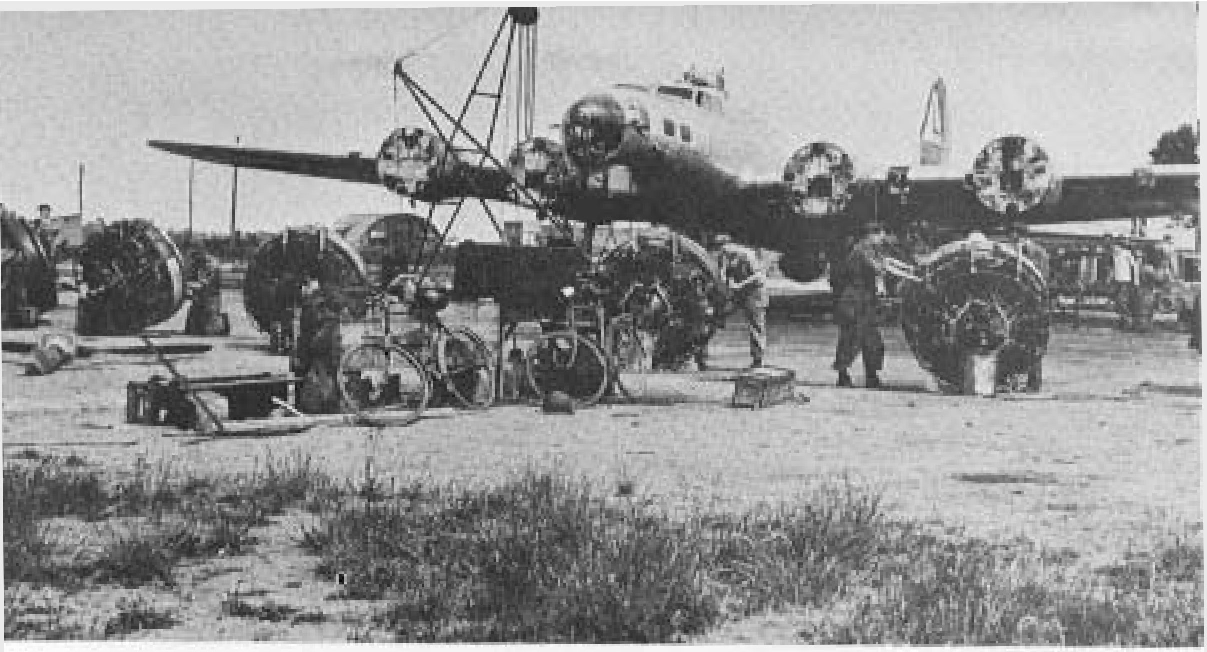
This enormous expansion had brought with it serious administrative problems. It proved especially difficult to maintain in the area depots reserve stocks sufficiently large to guarantee prompt meeting of all demands for supply of particular items. After extended study of the problem in 1942, it was decided to establish specialized depots, each of them, as a general rule, stocking only one property class or subclass of materiel. Thus the full stock in any class could serve as a reserve to meet promptly, on requisition from the several area depots,

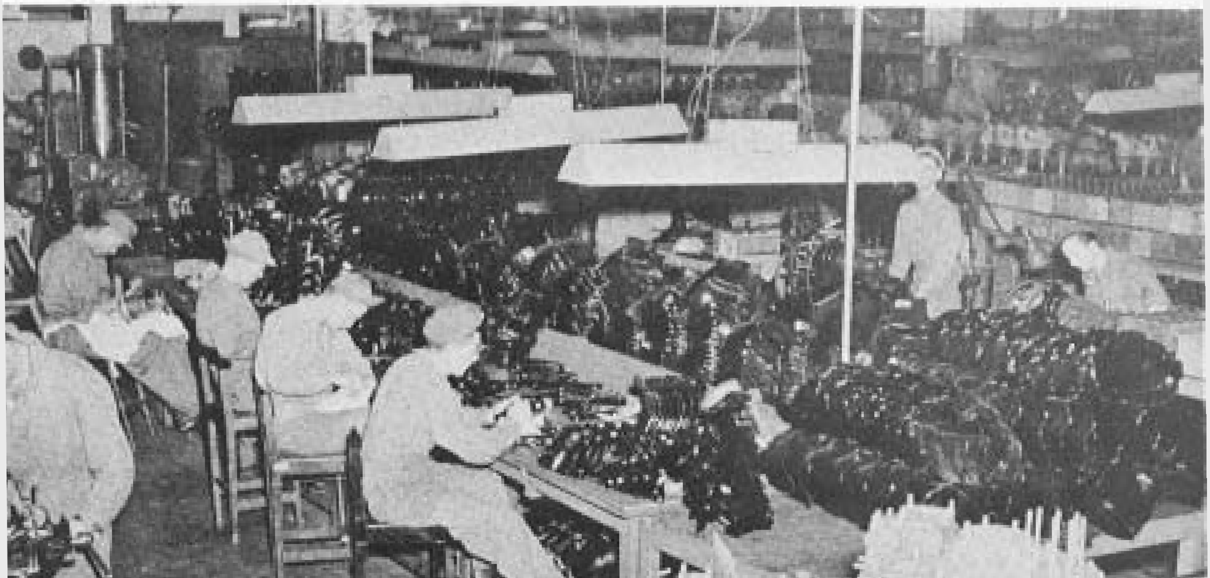


MAINTENANCE, STATESIDE

Above: At San Angelo Bombardier School, Tex.

Below: At Laredo Army Air Field, Tex.



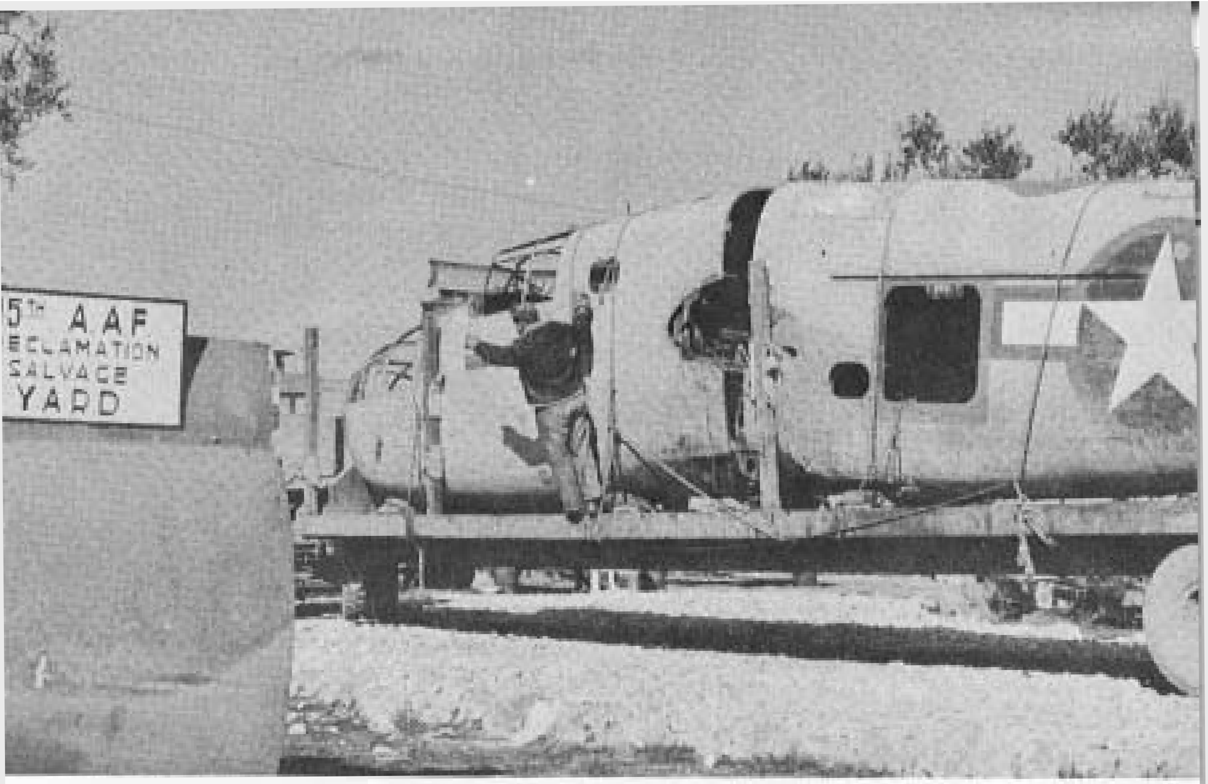


MAINTENANCE IN ETO

Above: Engine Change at Base in England

Below: Cleaning Spare Engine Parts, Warrington-Burtonwood Air Depot

PRODUCTION LINE METHODS IN REPAIR OF P-39'S
McCLELLAN FIELD, CALIF.



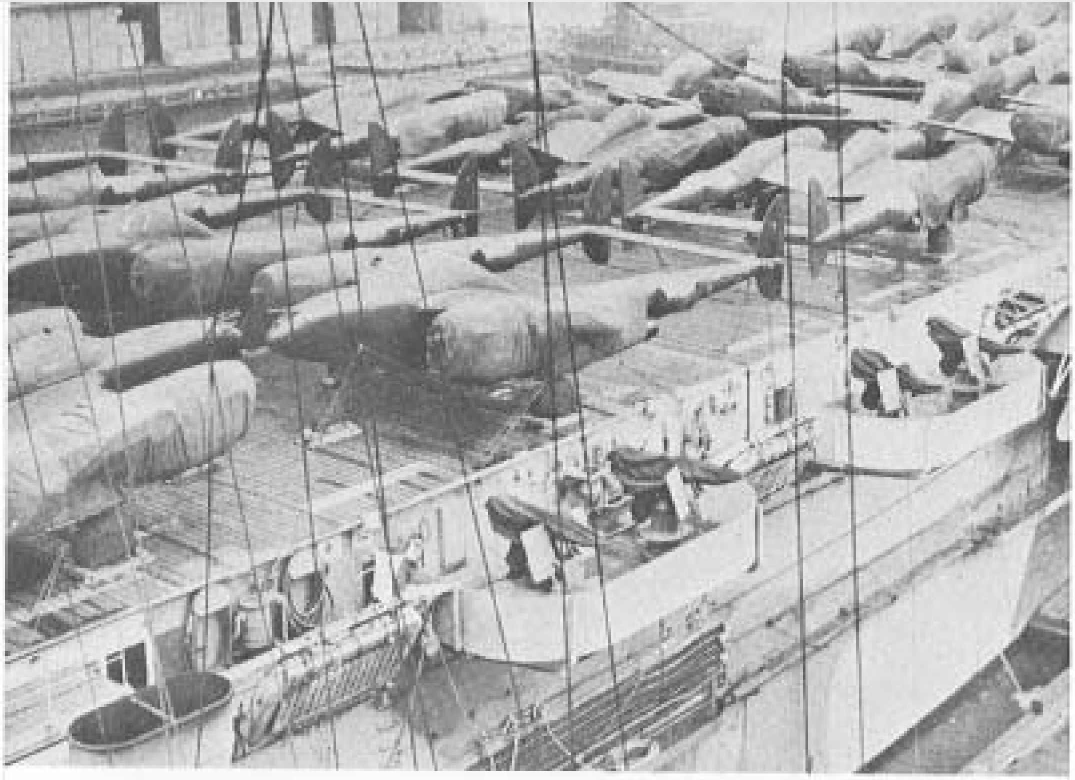
SALVAGE

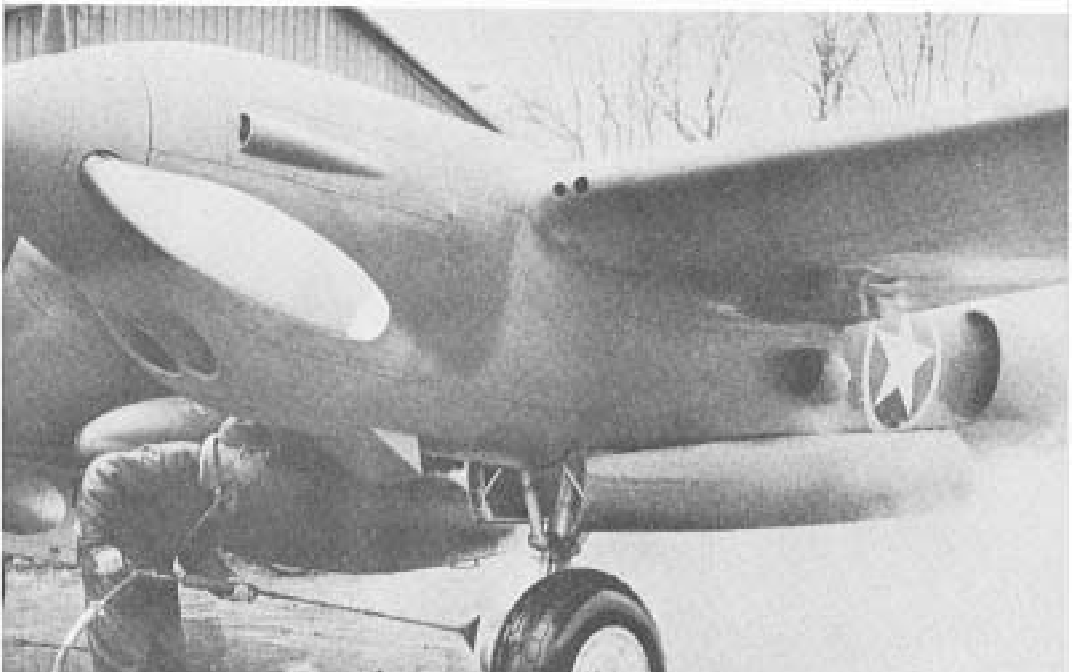
Above: Fifteenth Air Force Salvage Yard

Below: Salvage Hangar, 2d Base Air Depot, England

SUPPLY ON GUAM

Above: Oxygen for B-29 Crews — *Below:* Belly Tanks for Fighters

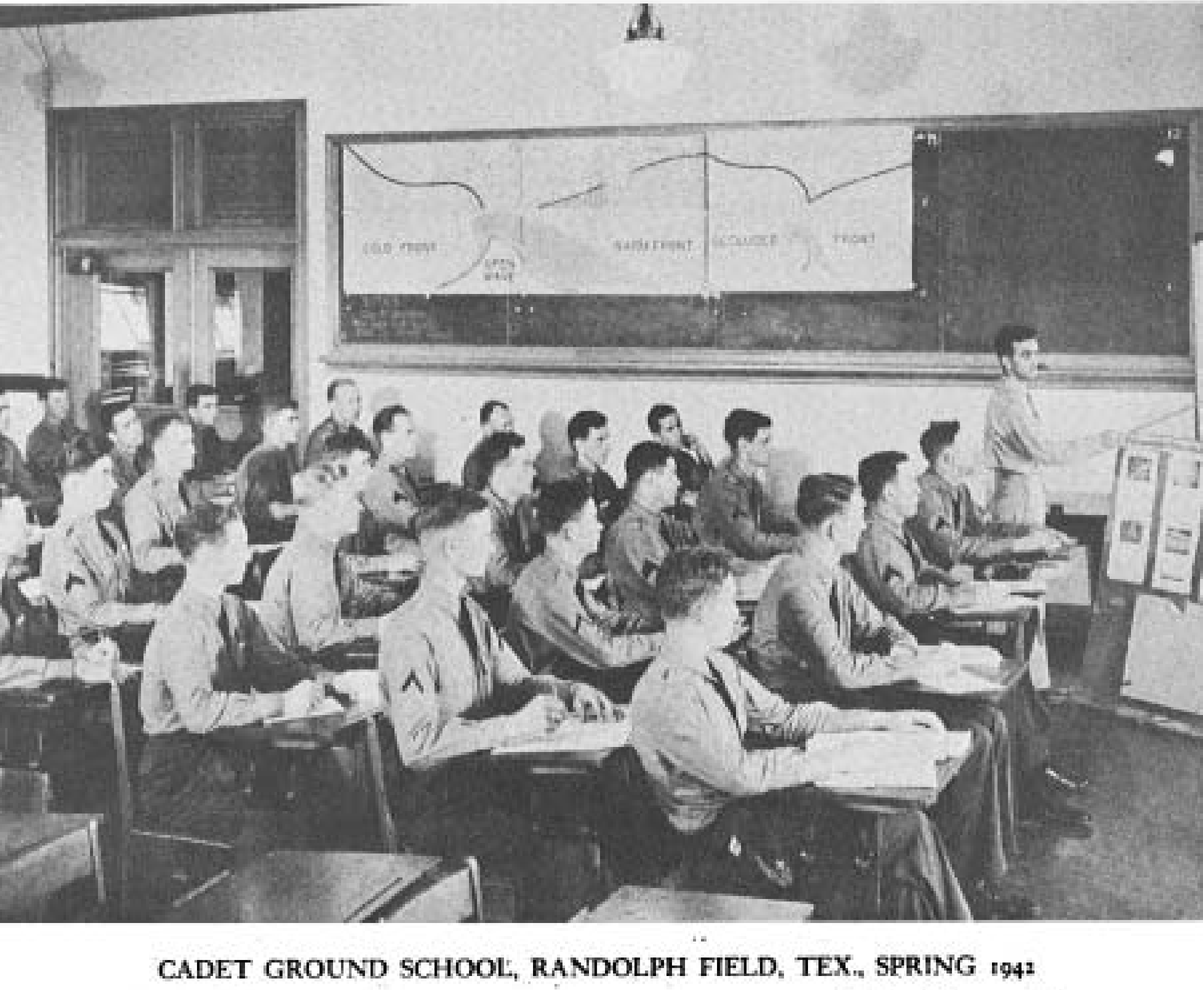




OVERSEAS DELIVERY OF FIGHTERS

Above: P-38's Deck-loaded on CVE

Below: Removing Protective Grease Coating in England



CADET GROUND SCHOOL, RANDOLPH FIELD, TEX., SPRING 1942

Above: Code Class *Below:* Weather Class

PRIMARY TRAINING, TUSKEGEE ARMY AIR FIELD, ALA.

the demand from any quarter. By June 1943 there were forty-two specialized depots, although only thirty-six were as yet in operation; the maximum number of such depots—probably sixty-eight—was reached at the end of 1943. Consolidations and inactivations had reduced the number to fifty by mid-1944. Most of them were located near aircraft plants, and many of the storage depots had been incorporated into the new specialized system, which General Frank described as the "backbone of Supply for the AAF."[41] The stocking of the specialized depots had required a tremendous readjustment of depot stocks and a consequent strain on the transportation system, but the advantage gained proved to be worth the effort.

ASC depots in August 1944 employed more than 280,000 persons,* military and civilian.[42] The materiel with which they were charged fell into two major categories—organizational equipment and maintenance supplies. Organizational equipment was that permanently issued to an organization for its use in the performance of a combat or service mission. Normally, tables of equipment prescribed for each type of unit the equipment, whether of airplanes or of tools to be provided for the mechanics' kit, necessary to the performance of its duties. Maintenance supplies included spare parts and such materials as might be required for the repair and overhaul of aircraft and other equipment.

The problems involved in the distribution of organizational equipment (other than aircraft, which are discussed elsewhere)† resulted from such causes as the unusually rapid activation of units during the earlier part of the war, shortages of various items of materiel, the lack of trained personnel at the supply depots and in the receiving units, and changes in supply tables and technical orders. The speed with which units were activated created a serious backlog of unfilled orders for organizational equipment during 1942, partly because of demand at times outrunning supply and partly because of administrative and transportation difficulties. New depots and new supply officers found it difficult to cope with the countless requests for efficient and speedy service, especially when the best efforts of the ASC reporting system failed to provide the basic data needed for efficient operation. Frequent changes in supply tables and in tech-

* This figure includes a large number who at area depots performed important maintenance services. See below, p. 390.

† See below, pp. 412–23.

nical orders made it all the more difficult to equip units as promptly as was desired.[43]

There was no sovereign remedy for these problems, and ASC applied itself painfully to such revisions of policies and techniques as would improve the flow of equipment to units—especially those going overseas. The simplification of property-accounting procedures reduced the burden of paper work on the combat unit and facilitated reporting of equipment status. But the basic problem remained that of getting equipment to newly organized units which had none whatsoever. It proved impossible to make equipment available to new units at their stations of activation because they frequently, if not usually, left these stations shortly after activation. The waste of transportation involved in transshipping equipment, sometimes several times before it could catch up with the unit, led to a policy of sending initial equipment to the first training station instead of to the station of activation. This gave the depots more time to assemble and ship the equipment.[44]

Eventually ASC determined that it would be more efficient to issue organizational equipment to units on their arrival overseas rather than at some phase of their training careers in the United States. The advantages of such a system included elimination of the time, effort, and materials involved in packing, unpacking, and transporting equipment among a series of stations in the United States. By issuing to operational training units and operational replacement units sufficient equipment for use by organizations undergoing training, the ASC made it unnecessary for the latter to carry such equipment with them from station to station during their training cycles.* The depots acquired enough breathing space under this system to allow them to preassemble and pack for overseas shipment full sets of equipment for every major type of AAF unit. In addition, a unit freshly equipped overseas imposed fewer burdens on local services for replacement of equipment, and its equipment at the time of its commitment against the enemy was of the latest. It could also be expected that more accurate accounting would result from the new system.[45]

The experience of overseas commands, as well as that of ASC, encouraged the adoption of these procedures. As late as the summer

* The equipment remained permanently at the training station for use by subsequent units.

of 1943, units still were arriving at their overseas stations ahead of their equipment, or with only a part of it. Troopships usually were faster than the cargo vessels on which the equipment was loaded, and it was not always possible to follow a practice of loading the unit and its equipment together. Sometimes units in the theater had to wait several months for their equipment. Beginning in the summer of 1943, ASC shipped preassembled sets of unit equipment to the overseas theaters anywhere from thirty to sixty days ahead of scheduled troop movements. Policy on organizational equipment thus came to be based upon two principles: equipping the unit only upon arrival at its ultimate station, with preshipment in such quantity as to guarantee a prompt supply; and stocking training organizations within the U.S. sufficiently to provide borrowed equipment for all units in training. The system worked so well as to raise a question as to why it was not adopted earlier. On this point, it seems fair to conclude that the system would not have been as successful had it been instituted earlier, for before 1943 the flow of materiel from the factories was probably not great enough to permit the provision of the dual sets of equipment on which the system was based.[46]

Maintenance or technical supplies were the indispensable complement of organizational equipment and constituted the bulk of the total AAF materiel distributed, especially during the last year of the war, by which time most of the units had been equipped.* In spite of shortages and transportation difficulties during the early months of the war, Zone of Interior needs presented no problem that could not be handled well enough through ASC's rapidly developing depot system. But the long overseas supply lines—up to 12,000 miles—required special policies and techniques in order to insure efficient operation.[47]

During the first twelve to fifteen months of the war the AAF relied on a system of automatic supply for provision of technical equipment to overseas theaters. Under this system the initial shipment would be followed by a continuing flow based on anticipated rates of consumption. It was found most convenient to ship such supplies in pack-ups—cases containing enough parts or materials to maintain a given number of planes for a given number of days. Originally, the manufacturers determined the composition of these pack-ups, but their ignorance of changing needs in the field, combined with their

* The B-29 groups were the chief exception.

inclination to include items of which they had a plentiful stock rather than those which were most needed, caused ASC to assume responsibility for selection of parts. The ASC developed supply tables which were lists of the maintenance and overhaul parts (items like gaskets, landing gear, wing tips) and supplies (sheet metal, rope, solvents, etc.) required for maintenance. There were many such tables, each designed to meet the requirements for maintenance of aircraft and equipment under a variety of circumstances at the several echelons* of maintenance.[48]

The AAF at first directed automatic shipment of sets of supplies in accordance with the supply tables until supply overseas "reached a satisfactory level." Because of the embryonic state of supply organizations in overseas theaters and the lack of accurate consumption data based on combat experience, this was probably the most effective method available to the AAF during 1942 and into 1943. But the North African campaign provided a service test for the automatic supply system which revealed shortcomings both in the operation of the system and the composition of the tables. As a result of a conference of overseas supply officers at ASC headquarters in April 1943, the automatic supply system was abandoned in the autumn of that year. Automatic shipments of pack-ups had been neither efficient nor economical, and the inability to change the supply table quickly in accordance with experience had resulted in large excesses of many items in overseas theaters while other and more critical items were in short supply. General Arnold and others had been impressed by the huge stocks of excess supplies they found in overseas depots and felt that the situation called for a different policy.[49]

* AAF Regulation 65-1, 14 August 1942, gave the following definitions of the echelons of technical supply:

1) *1st Echelon:* Supply facilities of the air echelon of the combat squadron. This consists of a 3-day supply level carried in the crew chief kit and is transportable by air.

2) *2d Echelon:* Supply facilities of the ground echelon of the tactical squadron. This consists of a 10-day supply level provided in the Squadron Engineering Set, T.O. 00-30-19.

3) *3d Echelon:* Supply facilities of the service group or subdepot. In the case of the service group, this consists of a 30-day supply level.

4) *4th Echelon:* Supply facilities of the Zone of Interior air depots and air depot groups. In the case of the air depot group this will normally consist of a 90- to 150-day supply level.

The above supply levels will, of course, vary with the particular situation depending upon distances involved, availability of supplies, and whether situation is static or mobile.

Supply tables, revised to bring them up to date and to render them more flexible, continued as the basis of automatic shipments for initial supply under the new policy, but all subsequent shipments were to depend upon specific requisitions from the overseas commands. Such requisitions had been employed from the first for replacement of organizational equipment and for counteracting the deficiencies of automatic supply, but now the requisition became the chief instrumentality in a system of continuing supply which left the responsibility for the determination of requirements with the using organization. Most of these requisitions were so routine that pack-ups retained their utility and normal supply took on many of the qualities of an automatic system. Special requisitions usually arose from some emergency, and their designation as "emergency requests" gave them higher priority for shipment. There were also special projects requiring shipment overseas in which the initiative came from within the Zone of Interior.[50]

The operation of a supply system based on requests from the users of materiel placed on overseas theaters the obligation to institute more accurate methods of stock accounting and distribution and to make stronger efforts to assemble valid consumption data. But it became increasingly clear during the latter part of 1943 that any system would result in the accumulation of excess stocks of supplies unless kept under constant surveillance. The understandable tendency at all echelons to acquire a cushion of supplies to meet all emergencies produced surpluses which sometimes amounted to as much as two years of normal supply of certain items at some of the depots. The achievement of full production by the end of 1943, with its promise of a continuing capacity for rapid replenishment of stocks, made it possible for the Army to survey the world-wide supply situation; the outcome of the survey was the so-called McNarney Directive (1 January 1944) which prescribed extensive changes in supply procedures and which established maximum stock levels for the whole Army. The stock levels set up for various classes of supply* ranged from 60 days in the European and North African theaters to as much as 180 days in China-Burma-India.[51]

* Army supplies were divided into five classes, of which classes I and III included such items as rations, fuels, and lubricants, consumed at an approximately uniform daily rate regardless of combat operations, while classes II, IV, and V included organizational equipment, airplanes, spares, ammunition, and supplies for which allowances were not prescribed or which required special measures of control.

The ASC made a determined effort to carry out the changes prescribed by the McNarney Directive. It reduced authorized inventories in its Zone of Interior depots to approximately a four and a half months' supply for domestic and three months' for overseas requirements from the previous six-month level for each. The reduction of stock levels in the overseas theaters proved to be much more difficult, for theater air forces still tended to build up to the maximum levels rather than reduce to the minimum consistent with effective operations. In the fall of 1944 excess stocks were apparently still the rule rather than the exception in overseas theaters. Although the ASC had been made responsible by the McNarney Directive for screening overseas requisitions in order to prevent the accumulation of surpluses, the lack of accurate and detailed information from the theaters continued to make it difficult to carry out this responsibility properly. The enormous scope of the supply system and the continued operation of factors making for frequent change—such as lengthening of supply lines, increase of aircraft and personnel strength, and special problems of transportation—made it virtually impossible to adhere strictly to any rigid theater stock levels. The ASC exercised wide discretionary powers in screening requisitions from overseas, but of necessity the theaters got the benefit of any doubt.[52] To deny supplies to forces engaged in combat, even in the name of greater efficiency and economy, would have been extremely difficult even under better circumstances than existed in 1944 and 1945.

Experience during 1944–45 profusely illustrated the need for great flexibility in administering the supply system. Maintenance of prescribed stock levels in overseas theaters required establishment of timetables covering the whole supply process from receipt of the requisition by ASC to and including the theater supply level permitted. The "requisitioning objectives" table which was developed ranged from 159 days for the European theater to 334 days for the China-Burma-India theater. Close adherence to these time objectives proved to be almost impossible because the actual period for filling requisitions varied greatly from class to class and item to item of supply. Under such circumstances, maintenance of a uniform requisitioning objective or stock level for all classes of supplies was impracticable. In the Pacific theaters, for instance, operations required frequent, long-distance movements of units from island to island. The need for rapidity of movement and continuity of opera-

tions often required that supplies for a single combat group be placed at two or three different locations in the combat area. The total supply need, therefore, was always fluctuating, exceedingly difficult to determine, and almost always in excess of prescribed theater levels. In the face of demonstrated need the ASC could not help but waive existing restrictions on supply levels.[53] As a result, most of the Pacific depots were well stocked during 1945.* The obvious lesson to be drawn from this experience is that the most economical supply system is not necessarily the best from the standpoint of combat operations. The ASC could only try to minimize the waste inherent in the waging of war.

For the transportation of AAF materiel overseas the ASC had to rely on other agencies, chiefly the Transportation Corps and the Air Transport Command. The great bulk of supplies went by water and, beginning in 1943, passed through the hands of the Atlantic and Pacific Overseas Air Service Commands. For the period January 1942–August 1945, AAF materiel shipped overseas by water totaled more than 19,000,000 measurement tons. More than a third of this amount went to the European theater, the scene of the AAF's most extensive operations. Between January 1943 and August 1945 the AAF shipped more than 45,500 tons of materiel overseas by air.[54]

The organization of supply in the overseas areas varied somewhat from theater to theater but had essentially the same characteristics. The larger theaters—European, Mediterranean, and Southwest Pacific—which had more than one air force in operation, eventually established theater air service commands in order to prevent the waste and duplication which would have resulted from competition for supply and equipment between two or more air forces. These theater air service commands received supplies from the United States, stored them in large base depots (sometimes in specialized depots), and distributed them to the individual air force service commands. Within the individual air forces there were advanced depots, usually operated by air depot groups, which kept the service units and the combat groups on the combat bases supplied with materiel. In other theaters with only a single air force, the air force service command operated the whole system.† The ASC advanced argu-

* Okinawa seems to have been an exception.

† For discussion of organization and operation of overseas supply systems, see previous volumes of this series, especially I, 628–39; II, Chaps. 18 and 19, *passim;* III, 126–34, Chap. 16, *passim;* V, Chaps. 3, 6, and 11, *passim.*

ments for extending its control of logistics to the overseas theaters, or at least as far as the ports, but did not succeed in convincing the War Department General Staff, the AAF, or the overseas commanders of the desirability of such a move.[55] The Zone of Interior supply agency, therefore, had to rely on cooperation from the overseas theaters in order properly to carry out its mission. The extent to which their cooperation was possible or forthcoming often determined the degree of success attained in carrying out the mission.

Maintenance

The character and the use of the military airplane had given to maintenance services a place of fundamental importance in the peacetime Air Corps. The greatly increased rate of operations, the high incidence of battle damage, and the growing complexity of the military plane during World War II made maintenance one of the most vital functions in the waging of the air war. The quality of maintenance was often the margin of difference between the life and death of an aircrew or the success and failure of a mission.

The term "maintenance" as applied to aircraft referred to all operations necessary to keep an airplane in safe and efficient operating condition, including servicing with fuel and oil, periodic inspection, minor and major repairs, and overhaul. During the war, maintenance was divided into four echelons, distinguished from one another by the amount of work, equipment, and manpower required.*

* AAF Regulation 65-1, 14 August 1942, defined and discussed the echelons of aircraft maintenance as follows:

1) *1st Echelon:* That maintenance performed by the air echelon of the combat unit.

2) *2d Echelon:* That maintenance performed by the ground echelon of the combat unit, air base squadrons, and airways detachments.

3) *3d Echelon:* That maintenance performed by service groups and subdepots.

4) *4th Echelon:* That maintenance performed by air depots groups and air depots.

First echelon maintenance will normally consist of servicing airplanes and airplane equipment, preflight and daily inspections, and minor repairs, adjustments, and replacements. All essential tools and equipment must be transportable by air.

Second echelon maintenance will normally consist of servicing airplanes and airplane equipment, performance of the periodic preventative inspections and such adjustments, repairs, and replacements as may be accomplished by the use of hand tools and mobile equipment authorized by Tables of Basic Allowances for issue to the combat unit. This includes engine change when the organization concerned is at the location where the change is required. Most of the tools and equipment for 2d echelon can be transported by air; but certain items, such as transportation, radio, etc., necessitate ground means of transportation.

Third echelon of maintenance embraces repairs and replacements requiring mobile

Actually, it was impossible to draw sharp lines between the various echelons, and in time it came to be recognized that such lines were neither necessary nor desirable. Accordingly, there developed a large degree of flexibility in the operation of the maintenance system, with the availability of equipment, supplies, and manpower determining the amount and kind of work performed by a given installation or organization.

Until 1941 the Materiel Division, although its control did not extend to GHQ Air Force bases, established the policies which governed the performance of maintenance at the various echelons. It issued orders, circulars, and letters prescribing the general organization and operation of depot and station engineering departments and the methods and routines to be followed. The basic data from which policies and instructions were derived came from reports which flowed in from the depots and stations and from various inspecting activities.[56]

In 1939 the four Air Corps depots in the United States employed in their engineering departments a total of 1,700 civilians under the supervision of Air Corps officers. Between 1931 and 1939 these depots overhauled an average of 166 planes and 500 engines annually. The Air Corps had fewer than 2,000 aircraft, the great majority of them single-engine, of all types during most of this period. Since a considerable number of the planes were deployed in overseas departments, leaving only a portion, albeit a large one, of total Air Corps strength to be serviced by the continental depots, their capacity was adequate for all needs. In August 1939 the Air Corps actually considered reducing the number of its maintenance employees,

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machinery and other equipment of such weight and bulk that ground means of transport is necessary. Units charged with this echelon of maintenance require specialized mechanics. This echelon includes field repairs and salvage, removal and replacement of major unit assemblies, fabrication of minor parts and minor repairs to aircraft structures and equipment. Normally, this echelon embraces repairs which can be completed within a limited time period, this period to be determined by the situation prevailing.

Fourth echelon of maintenance includes all operations necessary to completely restore worn or damaged aircraft to a condition of tactical serviceability and the periodic major overhaul of engines, unit assemblies, accessories, and auxiliary equipment; the fabrication of such parts as may be required in an emergency or as directed in technical instructions; the accomplishment of technical compliance changes as directed; replacement, repair, and service checking of auxiliary equipment; and the recovery, reclamation, or repair and return to service of aircraft incapable of flight.

and Arnold admonished his staff to economize in the depots. This was at a time when the Air Corps had already embarked on its 5,500-airplane program and when war in Europe was imminent. Fortunately, as these circumstances soon made it clearly undesirable to take such a step, the depots retained the nuclei of skilled technicians who later contributed much to the expansion of the AAF maintenance system.[57]

The pace of AAF expansion after the summer of 1940 was so rapid that the maintenance services found it almost impossible to meet the steadily growing demands made upon them. The establishment of the Maintenance Command in 1941 was, at least in part, the result of the urgent need for more and better maintenance. Leaders at AAF Headquarters spoke out frequently and strongly during 1941 and thereafter about the shortcomings of maintenance, but they neglected to assume that part of the responsibility which was properly chargeable to them. The strong emphasis on the acquisition of aircraft had tended to subordinate problems of supply and maintenance, and these problems received inadequate attention at the top levels of the AAF until they became acute enough to obtrude themselves on the "top brass."[58] The decision in 1939—already noted* —to put almost all of the funds made available to the Air Corps into complete aircraft explains in large part the critical shortage of spare parts which persisted through 1942. Hardly less significant was the failure to undertake expansion of the four original depots until late in 1940, months after over-all expansion plans had been drawn. Still another factor affecting the quality of maintenance in the earlier months of the war was the lack of adequately trained engineering officers and civilian mechanics to man the depots and subdepots. In part this lack may be attributed to the acute pressure of demand on the available supply, but in part it seems also to have resulted from a policy which gave the Air Service Command perhaps the lowest priority on officer and enlisted personnel.[59]

In the face of handicaps which were not of its own making, the AAF maintenance system grew rapidly during 1941 and prodigiously after Pearl Harbor. In late 1943 the eleven depots employed 65,000 people in their engineering departments, almost forty times as many as those employed in 1939. In addition, the facilities of seventeen airlines and twenty-two other civilian concerns were brought

* See above, pp. 347–48.

into service on a contract basis to supplement the work done in the AAF depots. These contractors worked chiefly on training and transport planes, while the depots reserved their facilities for the more complex combat types. As the training program declined during 1944, the commercial contractors were eliminated except that the airlines continued to overhaul ATC planes until the end of the war.[60] The extension of ASC control of maintenance to the subdepots on the air bases early in 1942 provided the unity which ASC considered so important to the accomplishment of its mission. In 1944, when the subdepots reverted to the control of the air forces and commands on whose bases they were stationed, the maintenance system had attained sufficient maturity to overcome most of the disadvantages which resulted from a split control of the function.[61]

Although the jurisdiction of ASC did not extend overseas, it was responsible for providing service units, equipment, and supplies for all AAF commands. In addition, it served as the clearinghouse for technical information and issued technical instructions for guidance of all service organizations. During 1941 and early 1942 it had been assumed that overseas maintenance organizations would be highly mobile and that they would rely on Zone of Interior establishments for the provision of some, if not many, fourth echelon services.[62] Actually, most theaters established depots which with time performed almost as wide a variety of maintenance services as did the depots in the United States. The existence of these large base depots introduced a high degree of flexibility into theater maintenance, relieving the air depot groups at advanced depots and the service groups on the air bases of a wide variety of tasks which might have rendered them less mobile and permitting them to concentrate on the important task of repairing battle damage. The European theater, with its huge base depots at Burtonwood and Warton in England and its service teams operating with the Ninth Air Force in western Europe during 1944 and 1945, probably affords the best example of the fixed service installation and the mobile service unit.* Of special importance to the latter type of organization was the mobile repair shop, a van equipped with necessary tools and machinery which rendered yeoman service in North Africa and Europe between 1943 and 1945.[63] The Pacific equivalent of the mobile repair shop was the floating depot—a Liberty ship converted into a supply and main-

* See Vol. III, 126–34 and Chap. 16, *passim.*

tenance facility, complete with machine shops. During the final year of the war a number of these vessels were used, lending important assistance in the Marianas until land-based depots could be established.[64]

As with supplies, successful maintenance depended greatly on a two-way flow of information between the field establishments and ASC headquarters. The primary source of information about specific technical difficulties was the Unsatisfactory Report (UR). Flying units submitted UR's on defective equipment, procedures, and forms to the ASC, which either advised appropriate remedial action or arranged for necessary research on the problem. The huge growth of the AAF and the introduction of myriad items of new equipment produced a tremendous increase in the number of UR's submitted. From a total of 10,480 in 1941 UR's increased to 169,521 in 1944 and 164,155 for the first eight months of 1945. Because it became impossible to answer each UR individually, and in order to attain the widest dissemination of information as to possible remedies, the ASC began in February 1944 to issue a semimonthly Unsatisfactory Report Digest which listed specific failures, cited the number of reports received on each failure, and suggested remedial actions.[65] Important information came also from technical inspectors who were to be found at all echelons of the AAF down to the base level. Their inspection reports proved to be of great value in correcting deficiencies of a broader nature than those which appeared in the UR's. Special conferences on maintenance problems at ASC headquarters and in the field contributed additional information of value in the formulation of over-all policy. General reports distributed by ASC served to bring to interested agencies helpful suggestions based upon a common experience with maintenance problems.[66]

On the line, the key to successful maintenance was provided by regular inspections of aircraft and engines for detection of wear or failure and for determination of such adjustments and special servicing as might be required. Of critical importance were the standards for determining when airplanes and/or engines should be sent to the depot for overhaul. By strict adherence to the best standards of inspection and routine maintenance, it was possible to lengthen the time interval between overhauls and thus to increase the force available for operation. Something of the success with which the maintenance function was performed is suggested by the fact that normal

time intervals between overhauls for both aircraft and engines increased greatly during the war. The suggested inter-overhaul time for the B-17 increased from 4,000 flying hours or 30 to 60 months of service in 1940 to 8,000 flying hours or 84 months of service in 1944. Inter-overhaul times for engines were shorter, for their intricate mechanisms were more susceptible to wear and breakdown. Even so, the time between engine overhauls also increased during the war. The time for the R-1820 series, for example, increased from 300–375 hours in 1939 to 500–650 hours in 1945.[67] There were other causes for this development—among them, improvements of design and in materials—but policies encouraging such a lengthening of the intervals could be justified only on the assurance that the job of routine maintenance was being well done.

During the earlier years of the war, maintenance services carried a heavy load of repair work. The desperate need for aircraft in most theaters argued so strongly for repair of the crippled or damaged plane that air depot and service groups were strained to provide the special skills, equipment, and materials to meet the demand. The problem was made all the more serious by the prevailing spare-parts shortage, which contributed its share to a far heavier emphasis on repair than had been anticipated or could be regarded as justified except in the context of desperate combat requirements. The difficulty was not fully overcome until late in the war, and improvement in the situation varied from theater to theater in accordance with existing priorities of allocation and supply. But by 1944 industrial production, by reaching a scale which allowed replacement of heavily damaged planes by new ones, had come to the rescue of maintenance services.* As the repair of battle damage became of less critical importance, ASC undertook to establish standards that would preclude uneconomical employment of time and labor on such work. In the depots the job became mainly one of modification and overhaul.[68]

Production achievements helped in still another way to reduce the

*The British placed much greater emphasis on repair throughout the war than did the AAF, because they were governed by economic considerations to a far greater extent than was the United States. The Air Ministry and the Ministry of Aircraft Production held that it was worth while to repair a plane even if it would require 90 per cent of the man-hours and materials needed to build a new one, because the 10 per cent saving was essential to prosecution of the British production effort. This policy was more feasible in the United Kingdom where the aircraft factories were little more than a stone's throw from the combat bases.

burden of maintenance by making possible the retirement from service of older types and models. In prewar years the War Department had projected for each model of aircraft a life span which ranged up to ten years for some types; combat-types were declared obsolete after six to eight years of service. During the war it was impossible to follow any obsoletion policy based on years of service because of tactical and technical requirements and the enormous increase in the incidence of use of all types of planes—particularly those in combat. Accordingly, the War Department permitted the AAF to declare equipment obsolete whenever "the development and availability of new types should make such action desirable" and eventually, in February 1945, permitted the commanding general of the AAF to pass final judgment on the obsoletion of equipment.[69] Of further assistance was the concept of war-weary aircraft which came into use during the war to describe individual planes that had outlived their combat usefulness and were retired from combat service. At the height of the air war in Europe during 1943–44, the average life of an Eighth Air Force heavy bomber was 215 days, during which it flew missions on 47 days and was undergoing some form of maintenance, repair, or modification for a total of 49 days.[70] The figures are heavily weighted by combat losses, and the planes not lost to battle or accident actually had a longer life. Nevertheless, these statistics serve to suggest the heavy weight falling upon the maintenance services and the advantage to them of a growing dependence on new and more modern aircraft.

As production increased, the serious shortage of spare parts which had so plagued maintenance operations at the beginning of the war disappeared. Throughout 1942 aircraft grounded for lack of parts (AGP) constituted one of the chief sources of concern at all levels of command.[71] As late as March 1943 General Arnold found 65 per cent of the planes at one B-17 training school grounded for lack of parts, but this was an exceptional case, for the over-all average in that month for training planes was 4.5 per cent. By June 1944 the figure for combat planes in the United States had fallen to 3.1 per cent and to 0.9 per cent for trainers. Overseas the AGP rate during the latter part of the war was at points better than that in the United States. In the Eighth Air Force it was below 1 per cent for the last six months of 1944 and, with the exception of one month, below 3 per cent for the Ninth Air Force for the same period.

Arnold noted that in June 1945 the XXI Bomber Command on Guam had an AGP average of 0.3 per cent, while the B-29's at combat-crew training bases in the United States had an AGP average of 4.3 per cent.[72]

It would be wrong, however, to attribute the success of maintenance services during the latter part of the war too largely to the advantages gained from the achievements of production. No less important was the solution of a problem of personnel. The basic difficulty stemmed simply from the fact that there were not enough skilled technicians to meet other demands for their services and still leave enough to man the air service and air depot groups, nor was there time to train the unskilled hands available to the all-round competence that traditionally had characterized the Air Corps' mechanics. In recruiting civilians for the depots and subdepots the AAF found itself in competition with the aircraft plants or other war industries, which often held a greater attraction for available workers. In securing military personnel, both enlisted and officer, ASC generally suffered from a lower priority than many of the other activities of the AAF. The problem was only partly met by a technical training program for military personnel which graduated hundreds of thousands of skilled or semiskilled technicians or by special training programs for the thousands of civilian employees recruited for service in depots and subdepots in the United States.[73] The solution depended as much, and perhaps even more, upon an adjustment of procedures and methods to permit effective utilization of the talent available.

Since it was impossible in the time available to train crews and staffs to the ideal level of competence, the ASC, like the aircraft industry itself, borrowed heavily from the devices of mass production industry. A piece of work which had formerly been done by one mechanic was broken down into two, five, ten, or even twenty different and simplified operations. The depots and subdepots in particular benefited from the introduction of a high degree of specialization. The experience of the base depots at Burtonwood and Warton in England is perhaps the best illustration of this development. In late 1943 and early 1944 thousands of unskilled and untrained men were shipped to the United Kingdom to help man these rapidly expanding depots.* In order to make use of this manpower

* See Vol. II, 640–41, 659–60.

as quickly as possible, already specialized jobs were further subdivided until it became possible for the untrained men to learn on the job. The resulting use of manpower was certainly not efficient, but there was no other way to use their services as rapidly.[74]

The introduction of assembly-line techniques had first come in connection with routine inspections of aircraft in Zone of Interior subdepots. The traditional practice had been for a crew leader to move with his assistants from plane to plane cleaning up jobs of repair, replacement, or adjustment as he went. But experiment soon proved the advantage of routing the plane from station to station, at each of which specially trained mechanics inspected particular parts and made the repair or change required. The use of this technique spread very rapidly during 1942 and 1943 as the number of planes assigned to each base increased and as experience demonstrated that superior maintenance could thus be had at lower labor costs.[75] The same technique could be, and often was, applied to the problem of assembling overseas aircraft that had been shipped only partly assembled.

The percentage of U.S.-based planes grounded for maintenance (including inspection, repair, and alteration) averaged less than 20 per cent for the last two years of the war.[76] In January 1944, Arnold reported to the Secretary of War that of every 1,000 combat airplanes being delivered to the AAF, 620 were being sent to combat theaters, where, on an average mission day, 279 (45 per cent) would be out of service for modification and maintenance while 341 (55 per cent) would be available for missions.[77] The higher percentage here for planes out of commission reflects the costs of battle, and the figure given by Arnold represents an over-all average. The Ninth Air Force, for one, showed a record better than the average. After it had attained maximum strength in June 1944, its percentage of operational aircraft in tactical units averaged over 60 per cent of the total air force inventory, and aircraft out of commission rarely approached 40 per cent.[78]

These Ninth Air Force figures may perhaps be used to provide an easy illustration of a fundamental problem affecting the rate of air operations. To keep an average of 60 planes ready for combat, it was necessary, even with maintenance services operating at a high level of proficiency, to have a force of no less than 100 planes on hand. Should the total number of planes available fall below the

number required to uphold this 5:3 ratio, it could not reasonably be expected that even the most efficient maintenance services could make up the difference. The overwhelming air superiority enjoyed by the AAF in the closing years of the war was to be attributed as much to the productive achievements of the aircraft industry as to the effective organization of logistical services. During the last year of the war the AAF maintained overseas a total combat aircraft strength of approximately 24,000 planes, which was almost twice the total prescribed unit equipment strength of its combat groups committed to overseas operations.[79] It was this surplusage of equipment that gave to the maintenance services an opportunity for the most "economical" employment of their personnel and facilities.

In one sense the use of materiel was prodigal. The cushion of aircraft strength provided may have resulted from nothing more than the tendency of the military to take advantage of the American wartime psychology which raised no awkward questions as to cost but which would inflict severe penalties on those guilty of underestimating the national need in time of emergency. The effects of such an attitude can be uneconomical in every way except that the end result tends to an economical expenditure of the lives of those who fly the planes.

CHAPTER 12

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ALLOCATION AND DISTRIBUTION OF AIRCRAFT

ALTHOUGH the United States produced almost 300,000 aircraft between 1 July 1940 and 31 August 1945, the demand for planes exceeded supply during the greater part of that period. Hence, the allocation of aircraft among the various claimants—of which the chief were the AAF, the U.S. Navy, Great Britain, and the U.S.S.R.—remained an acute problem throughout most of the war. Within the AAF itself there were also critical decisions to be made on the allocation of available aircraft among its many commands, though the decisions of higher authority on over-all strategy tended usually to govern the choice. And once the decision on allocation had been made, there remained the problem of delivery, a problem made difficult by shortages of shipping and by supply lines so elongated as literally to encircle the globe. It is with these two aspects of the logistical problem that the present chapter is concerned.

Allocation

During 1939, when foreign and commercial orders often received priority over Air Corps claims, there had been no compelling reason for the establishment of special controls over the allocation of U.S.-produced aircraft. Such questions as arose were easily enough settled by such consultations as that which led to the Air Corps' agreement in March 1940 to defer deliveries on its own orders in favor of British and French claims on American production.* The American defensive effort required time to get into high gear, and the urgency

* See above, pp. 302–3.

of Air Corps needs was not so great as to preclude considering deferment of its orders as an actual military advantage which would give it later aircraft models. But the German conquest of western Europe in the late spring of 1940 radically altered the American strategic outlook. That only Great Britain stood now between Germany and the Atlantic approaches to North America was a fact which strengthened the argument for doing all that was possible to bolster Britain's defenses. But at the same time, no responsible U.S. official could be certain of England's ability to withstand further German assault, and this consideration argued for a greatly accelerated development of the United States own rearmament programs, among which the aircraft program stood first. Expansion of the aircraft industry itself had only begun, and plans for still larger expansion would require time for their implementation. The immediate demand for aircraft pressed hard upon existing facilities, and how to allocate the limited production most wisely became a most difficult and important problem.

As the British took over French contracts early in the summer of 1940 and prepared to place additional orders that would bring their total demand on U.S. production to some 14,000 planes, the Air Corps was fixing its requirements at 21,485 planes (including 2,844 undelivered on old orders), and the Navy planned procurement of 7,997 planes (including 941 undelivered on old orders). All purchasers desired the earliest possible delivery; hence, to avoid the disruptive and wasteful competition of unregulated purchases and deliveries, the War Department took the lead in bringing about an understanding among the three major agencies involved. At a meeting on 23 July 1940 representatives of the Air Corps, the Navy's Bureau of Aeronautics, and the British Purchasing Commission arrived at an agreement on allocations to be made through 1 April 1942. Deferring to the greater and more immediate need of the British, the Air Corps reduced its requirements from 21,485 to 12,884 planes, and the Navy scaled down its share to 6,208.[1] These Air Corps and Navy concessions made it possible for the British to receive a larger allocation—14,375 planes—for the same period.* The Air Corps expected that the 8,601 airplanes it had agreed to defer until after 1 April 1942 would be advanced models comparable to the best foreign ones.

* For the delivery schedule, see above, p. 267.

The Joint Aircraft Committee, established in September 1940 as the chief agency for coordination of Anglo-American aircraft requirements, had its jurisdiction extended in January 1941 to include review of all foreign contracts. This committee, a combined Anglo-American agency,* was concerned more with the allocation of production resources than with that of completed aircraft. However, since production allocation determined what planes eventually came from the factories, JAC played an important part in regulating the final allocation of accepted aircraft. The ultimate power of decision lay at the highest political and military levels, and for the basic policy underlying allocation and deliveries of aircraft during 1940 and 1941, a policy of maximum aid to the British even at Air Corps and Navy expense, President Roosevelt himself was responsible. In November 1940 the President ruled that planes coming off the production lines should be divided 50–50 with the British. During 1940–41 the frequent deferment of American deliveries and allocation to the British of planes from Air Corps contracts delayed the fulfillment of the Air Corps' own program.[2]

Passage of the Lend-Lease Act in March 1941 firmly established the concept of an American production pool from which allocations would be made to the several claimants. Policies that would govern these allocations were clarified by American and British staff conversations held in Washington during the first three months of that year for the purpose of determining the common strategy to be followed "should the United States be compelled to resort to war" against Germany and her allies.† The Americans agreed to a further stretch-out of Air Corps expansion in order to meet increased British requirements during the coming year: in addition to the 14,375 planes agreed upon in July 1940, the British would receive 12,000 more aircraft, and, until such time as the United States might enter the war, the production resulting from new capacity. Actual deliveries would be governed by the ability of the recipients to "absorb material usefully, either for the equipment of operating units, or for reserves of such magnitude as may be agreed upon, according to Military circumstances."[3] The conferees adopted no definite schedules but confirmed the general principle that current military need might override all other considerations. To adjust to such

* For a discussion of its organization, see above, pp. 273–74.

† See Vol. I, 136–39.

military contingencies, the Chief of Naval Operations and the Chief of Staff, after coordination with the British Staff Mission in Washington, were responsible for advising the President on specific allocations.[4] The Joint Aircraft Committee continued to serve as the coordinating agency, and through it AAF and British representatives shaped agreements for submission to higher authority. The work of the committee was of special importance to the AAF, not merely because the immediate interest of the AAF was so deeply involved but also because the committee had assumed responsibility, under the Defense Aid Control Office and later the Office of Lend-Lease Administration,* for cognizance over the production of most of the aircraft allocated to other powers. Thus, though the committee represented only the Anglo-American services, it also made necessary recommendations on the claims of the other Allies.[5]

After the German invasion of the Soviet Union in June 1941, Russia became an additional claimant. The President proclaimed the Russian resistance to the German invaders vital to the security of the United States and directed that the U.S.S.R. be given top priority in allocation of materiel. In August, as a beginning, the United States promised the Russians forty P-40's and five B-25's; in October American and British representatives at Moscow, after conferences with Stalin and his staff, promised that each of their countries would deliver approximately 1,800 airplanes to the U.S.S.R. before 1 July 1942. A substantial portion of the British contribution would, of course, have to come from the planes allotted to it from United States production. This first Soviet protocol (dated 1 October 1941), like the three subsequently entered into by the United States, was regarded as a contract so binding as to leave no room for debate as to its possible revisal. There was a certain flexibility as to Anglo-American agreements, and the two powers possessed in the JAC an agency through which adjustments could be made by common agreement. But with Russia, relations were on a fundamentally different basis. The four protocols were negotiated on the highest political level, and they left the AAF no real choice but faithful administration of the responsibilities for execution assigned to it.[6]

These new demands on American production caused grave concern to AAF leaders over the actual and potential effect on the build-

* This office, established in October 1941, succeeded the Defense Aid Control Office, which had been set up in May 1941.

up of its own forces. At the end of November 1941 the AAF had sixty-four operational groups, but only forty-seven of these were of combat type, the rest being troop carrier and observation groups. In other words, the goal of fifty-four combat groups set in June 1940 had yet to be attained, not to mention the 84-group program approved in March 1941. As of 30 September 1941 AAF combat planes suitable for use against a modern air force numbered 1,599. The 2,846 first-line combat planes on hand at the end of November, just on the eve of Pearl Harbor, included models which were at best obsolescent. Out of the total production for 1941 of 8,540 combat planes, the AAF received 2,919 or less than 35 per cent of the total, and this number included types like the B-34, A-29, A-30, and P-43 which proved of little utility in actual combat service. In contrast, the RAF received almost 50 per cent of the total production of combat types—4,211 planes.[7] This division was in accord with established policy, and from the long-range viewpoint there can be little question that the policy was sound. Not only did the bolstering of British strength promise additional time for mobilization of the United States, but the emphasis placed on aid to nations actually fighting the Axis powers broadened the base of prewar industrial mobilization with results that gave the United States many advantages during the war years. It should be noted, moreover, that the nearly 6,000 training planes received during that year by the AAF were of more fundamental importance to its ultimate development than were combat aircraft.

Nevertheless, the AAF had cause for concern in the fall of 1941. The very emphasis which the RAF placed on heavy bombers promised conflict with the AAF's ambition to equip itself for the strategic bombing campaign set forth in AWPD/1 of September 1941. This was also the time when plans for strengthening the defenses of the Philippines as a deterrent to Japanese aggression emphasized the early deployment of four heavy bombardment groups to that area, a deployment which the AAF as yet lacked the resources to perform fully.* Of more general importance, the whole situation in the Pacific carried a warning that the AAF might be involved in war at an earlier date than had been anticipated. In these circumstances, and with Russian claims on American production threatening new limitations on AAF expansion, it was only natural that Arnold

* See Vol. I, 176–85, 192.

should have felt compelled to press the claims of U.S. defenses.

In September 1941 he proposed that an anti-Axis pool of aircraft be created to include all lend-lease planes, all production on earlier British contracts with American manufacturers, any other foreign contract production, and 15 per cent of combat planes produced for the AAF. He estimated that the pool would receive 66 per cent of all combat aircraft (excluding Navy planes) to be produced by 30 June 1942; out of an estimated total production of 14,802 combat planes, the pool would get 9,708 and the AAF 5,094. This last figure would permit the AAF to attain its minimum required strength of fifty-four combat groups, and upon attainment of that strength 30 per cent of the aircraft produced for the AAF could be diverted to the pool.[8] The proposal, in short, was to fix some limit on foreign claims in order to insure early achievement by the AAF of the minimum goal set in the 54-group program. On the question of giving first claim on heavy bomber production to the equipment of four groups for the Philippines, the AAF had its way, but the President continued to support a view that the British should share the production thereafter.* And on the general question of allocations, the AAF had to be content with a lower figure for itself than had been hoped for in September. A schedule announced by Arnold on 29 October, with approval of the Chief of Staff, indicated that production through 30 June 1942 would be allocated as follows: the AAF, 4,189 combat planes; Great Britain, 6,634; the U.S.S.R., 1,835; China, 407; and other nations, 109.[9]

The immediate effect of Pearl Harbor was a drastic alteration of the balance of considerations theretofore governing aircraft allocations. The President agreed to Stimson's request of 9 December that the War Department be permitted to take over planes produced for lend-lease and on British contracts in order to build the AAF up to its 54-group strength by 1 January 1942, and two days later Arnold could report that the AAF had taken over 1,100 planes originally intended for shipment to the RAF. But many of these were subsequently released to the British, and the final number retained was only about 500.[10] It was evident that the organization and equipment of U.S. combat units had to proceed at a rate as rapid as the programs of recruitment, training, and production would permit. But it was also evident that the complex interrelationship of the several programs was such that for many months to come Allied forces more heavily en-

* For fuller discussion of this and related issues, see Vol. I, 133-35.

gaged with the enemy would have claims on American production that could not safely be ignored. Upon striking a proper balance between the two classes of claims might depend the outcome of the war itself.

Fortunately, the American and British governments moved promptly to provide the necessary machinery for an effective collaboration on this and other problems. At the Anglo-American conferences in Washington which followed hard on the Japanese attack on Pearl Harbor, it was agreed that "the entire munitions resources" of the two countries should constitute a "common pool" for support of their respective armed services. A Munitions Assignments Board* was established in intimate association with the newly established Combined Chiefs of Staff as the agency through which agreement on allocations would be reached. Like the Combined Chiefs, the new board was a dual organization. In effect, there were two boards, one in Washington and another in London; but the two boards worked closely together, with the services of both countries represented in each case, and for practical purposes the board in Washington, with Harry Hopkins serving as its chairman, was the Munitions Assignments Board. The body functioned through three major subcommittees—for naval, air, and ground materiel respectively. The Munitions Assignments Committee (Air) was composed of American and British representatives under the chairmanship of a high-ranking AAF officer. Through subcommittees of its own, the Munitions Assignments Committee (Air) prepared for the board's formal approval the assignments schedules for air materiel; the board's decisions could be reversed by appeal to the CCS. As with JAC, the committee might exert a very real influence in the shaping of policy, but the power to decide rested at a higher level of authority.[11]

Questions involving the two U.S. services required the creation of no special machinery, since the newly developing agencies of the Joint Chiefs of Staff served well enough to work out necessary agreements. Except where Navy demands for Army-type planes met AAF resistance,† there were few problems, for the two services depended basically upon different types of planes, and the original agreement of 1940 as to the proportionate division of the President's 50,000-plane

* See Vol. I, 256–57.

† The AAF particularly resisted Navy efforts to secure large numbers of land-based bombers, especially B-24's and B-25A's.

program stood up well enough.* The division of airplane production agreed on for 1942 and 1943, using the President's January 1942 target goals, was as follows.[12]

	1942	*1943*
AAF	34,830	78,210
Navy	10,170	21,790
TOTAL	45,000	100,000

This was an agreement on the division of "futures" and, as such, was subject to frequent adjustment. The totals also included planes scheduled for lend-lease, most of which were of the Army type.

The greater part of the production scheduled for foreign use was allocated to the British and the Russians. Shipments to the Russians under the first protocol, signed in October 1941, fell into arrears almost immediately and were further delayed by the overriding priority asserted by the AAF in the weeks immediately following Pearl Harbor.† Thereafter, President Roosevelt consistently urged that the protocol commitments be met in full and on schedule, and only the most urgent considerations could justify deviations from the schedule. Nevertheless, the AAF steadily opposed the shipment of heavy bombers and scaled down the quantities of scarce transport planes made available. In the spring of 1942, for instance, with the strong support of General Marshall, Arnold succeeded in having the CCS reverse a decision of the Munitions Assignments Board to send twenty-nine transport planes to the Russians in May and June of 1942.[13]

Subsequent protocols were for fiscal years 1943, 1944, and 1945, during which time the United States offered and made good on delivery of more than 9,000 planes. Including the 1,800 planes for the period of the first protocol, 1 October 1941–30 June 1942, the total was close to 11,000. In addition, the United States shipped American-built planes to the U.S.S.R. on the British account. In all, the United States between 22 June 1941 and 20 September 1945 delivered to Russia, on its own and on the British account, almost 15,000 aircraft, of which all except 186 were AAF-type planes. P-39's, P-40's, P-63's, and A-20's comprised more than 80 per cent of the total.[14]

Although the successive Russian protocols constituted a first charge on American aircraft production during most of the war, the British

* See above, p. 265.

† See above, p. 403.

remained the chief foreign recipient of United States planes.* Allocations of American aircraft production, therefore, became essentially an Anglo-American affair, with due, and sometimes overriding, consideration given to the requirements of the U.S.S.R., China, and other countries. In practice, the master allocations agreements were made at intervals (generally semiannually after 1942) between General Arnold and his staff on one side and ACM Sir Charles Portal and his staff on the other. These agreements were then submitted to the CCS for final approval. They were frequently amended in detail, as circumstances dictated, and the Munitions Assignments Committee (Air) carried out the work of allocating the completed planes as they came from the assembly line.

At the beginning of 1942 the British had been at war for more than two years and had trained and deployed large forces. They argued that forces in being which could be brought to bear against the Axis should have first priority in the allocation of munitions. The Americans, on the other hand, facing the task of training and equipping a force of 115 combat groups, which was the program adopted in January 1942 for fulfillment by the end of that year, desired to avoid obligating large quantities of materiel too far in advance. They feared also that the more experienced and better-organized British would come to dominate the military relationship between the two countries, leaving the American military services with less freedom of action than they wanted. Conferences between the two air services in Washington resulted in the Arnold-Portal agreement of 13 January 1942, specifying a month-by-month allocation of planes to the United Kingdom during 1942. From American production the British were to get 589 heavy bombers, 1,744 medium bombers, 2,745 light bombers, 4,050 pursuit planes, 402 observation planes, and 852 transports—a grand total of 10,382 planes exclusive of trainers.† The Munitions Assignments Board, by accepting the agreement as a guide to allocations, set a procedure that would be followed thereafter.[15]

Within less than two months Arnold concluded that the allocations to the British and Russians would not permit the AAF to equip the 115 combat groups it hoped to have by the end of 1942. He pointed out to the Joint Chiefs of Staff at every opportunity during ensuing months that the RAF maintained a 100 per cent reserve of aircraft

* See above, p. 352.

† See Vol. I, 248*n*, for full table.

while the AAF did not have enough planes to equip its programmed groups, that the many uncrated American planes in Great Britain showed that the RAF could not use all of the aircraft allotted to it, and that American operational commitments could not be carried out unless the AAF received a larger share of United States aircraft production. With these and other arguments he sought to secure adoption of the policy that U.S.-built planes wherever possible should be fought by American pilots.[16] Plans then under discussion for an early offensive against the Germans and the adoption of a program for a preliminary build-up of U.S. air forces in the British Isles* lent support to his arguments.

After intense study by the War Department and the Joint and Combined Chiefs of Staff, Arnold's proposal went to the President for decision. On 19 May Roosevelt notified Churchill that it was evident that

> under current arrangements the U.S. is going to have increasing trained air personnel in excess of air combat planes in sight for them to use. We are therefore anxious that every appropriate American-made aircraft be manned and fought by our own crews. Existing schedules of aircraft allocations do not permit us to do this. . . . My thought is that the CCS, with your approval and mine, would determine the strength of aircraft to be maintained in the respective theaters of war.[17]

At a White House meeting with his military advisers on the following day the President affirmed his adherence to the principle that all "American built combat planes in all the various theaters of the world would in general be manned and operated by American personnel." The chief exception to this rule would be Russia, where because of "geographic, logistic, and racial problems the American planes will in general be flown and maintained by Russians."[18]

In a quick follow-up to the President's message to Churchill, General Arnold and Rear Adm. John H. Towers, head of the Navy's Bureau of Aeronautics, flew to London, where they met with British leaders during the last week of May. The resulting agreements were essentially a compromise of the British and American positions, but the British allocations were scaled down substantially. The final Arnold-Portal-Towers agreement,† formally signed in Washington on 21 June with AVM John C. Slessor acting for Portal, was approved

* See Vol. I, 563–66.

† Sometimes referred to as Arnold-Slessor-Towers agreement.

by the JCS on 25 June and by the CCS on 2 July.[19] British allocations from AAF production for the seven months from June through December 1942 were cut from almost 7,000 to a little more than 3,000 planes.* The cuts were especially heavy in the categories of planes most important to the AAF—heavy bombers and fighters—but the United States agreed to continue through 1943 the allocation of aircraft necessary to compensate for attrition in British squadrons equipped with American aircraft and operational on 1 April 1943. In return for the British concessions, the agreement specified the American air units to be assigned to British and combined theaters, thereby preventing any decline in air power which might result from the loss of plane deliveries to the British.

In the AAF view this agreement had established a principle which should govern all subsequent allocations for British forces. In support of its commitment to provide the crews for U.S.-built planes, the AAF devised a 273-group program, which was approved in the autumn of 1942; at that time the AAF planned for an additional allocation of only 2,125 combat aircraft to the British to cover replacement requirements for the last nine months of 1943 in British units fighting with American equipment. The British, however, requested 3,870 aircraft for 1943.[20] To resolve differences of opinion arising as to the units covered by the previous agreement, the rates of attrition to be used, and other points, Sir Oliver Lyttelton, British Minister of Production, headed a delegation to Washington which conferred with the President and his advisers. The outcome, with reference to air materiel, was somewhat more generous to the RAF than the AAF had originally intended. Under the provisions of the new Arnold-Evill-McCain-Patterson agreement of December 1942,† the British were to receive 4,174 combat aircraft from AAF production during 1943. This allocation was based on an estimated production during 1943 of 59,000 combat aircraft. In addition, 600 C-47's were tentatively allocated to the British, along with 437 U.S. Navy planes to the RAF and 1,901 to the Royal Navy. The United States would also send 1,800 aircraft to the Russians under the United Kingdom account. Should production exceed estimates, allocations were to be reviewed in May 1943.[21]

* Annexes A and B, giving details by type and the agreed assignments to the several theaters of American air units, are reproduced in Vol. I, 568*n*, 569*n*.

† In addition to Arnold, the signers were AM Douglas C. S. Evill, RAF; Rear Adm. John S. McCain, USN; and Rear Adm. Wilfrid R. Patterson, R.N.

In the months which intervened before the adoption of another allocation agreement in July 1943, the rapid acceleration of American aircraft production promised to provide the AAF with all of the planes it could profitably use and possibly more. The result was a relaxation of the attitude that had governed previous negotiations. In April 1943 Arnold could advise his staff that a controlling principle on the question of allocations thereafter would be this: "Planes which cannot be absorbed in units by the United States within the period of a month will be given to other nations." At the end of June he notified the President that in the current review of proposed 1944 allocations "we have proceeded on the assumption that we must meet every bid made by our Allies except where such actions: a. Require a modification in our production program. b. Encroach upon our own deployment and training program. c. Result in an obvious wastage of airplane resources."[22] Nonetheless, the preliminaries to the signing of the Arnold-McCain-Courtney-Portal agreement* early in July 1943 were, as usual, essentially "horse-trading" sessions which reconciled the British bids for aircraft and the AAF's counteroffers. The total deliveries from AAF production of combat planes to the RAF for 1943 were revised and set at 4,187 (including 550 transports), and the allocation for the first half of 1944 was set at 3,221 planes (including 715 transports). The substantial increase for 1944 reflected higher production prospects as well as the approaching aircraft saturation of the AAF. From U.S. Navy production the RAF would get 1,254 planes during 1943 and 216 during the first half of 1944, and the Royal Navy was to get 1,778 planes. The agreement also stipulated the allocation to the AAF of 120 Mosquitoes and 350 Spitfires from British production for the period 1 June–31 December 1943.[23]

Before the next Anglo-American review in November 1943 of aircraft allocations, Arnold asked the President to establish as guiding principles that the AAF should have first priority on U.S. production for completion of its 273-group program and that aircraft should be allocated among other countries in proportion to their ability to use those aircraft in planned operations. Arnold also requested the President to approve as a fundamental rule the principle that commitments should be made with the understanding that all participants would share proportionately in any reduction which might be caused by actual production's failing to meet that estimated. He pointed out that

* The British signers were ACM Sir Christopher L. Courtney and Rear Adm. Reginald H. Portal.

the AAF would have received 1,555 more airplanes during 1943, based on 30 September 1943 estimates, if all nations had shared proportionately.[24]

The President appointed Arnold and the Navy's Deputy Chief of Naval Operations (Air) as a special committee to negotiate an allocation agreement with the British to be based on these principles. The resulting Arnold-Courtney agreement was approved by the President and the CCS in February 1944. Out of its estimated production of 57,876 combat planes, the AAF agreed to provide 11,148 for lend-lease (including the British planes). After allocating planes to the U.S. Navy also, the AAF would have left an estimated 43,018 planes for its own use. These estimates were based on delivery of 90 per cent of the 1944 production schedule.[25]

Anglo-American allocations agreements concluded during 1944 and 1945 presented fewer problems than had those of preceding years. Both British and American aircraft production reached their highest levels during 1944, and both the RAF and the AAF attained their maximum aircraft strength. After the middle of the year, except in special cases of which the B-29 is the outstanding example, aircraft requirements were primarily for replacements rather than for initial equipment of units. The AAF anticipated, however, that the British and the Russians would probably request allocations of planes with which to equip units for participation in the war in the Pacific after the defeat of Germany. As early as April 1944 AAF leaders were concerned about this probability and how the impending surplus of aircraft production might affect the question. Arnold did not wish to provide the British with the types of bombers and fighters which would permit them to play an important role in the Pacific war, which had been the private preserve of the AAF and the U.S. Navy almost from its inception. Considerations other than service prestige were involved. The extension to the Pacific of the coalition type of warfare familiar in Europe would have created serious logistical problems, among which the provision of adequate bases perhaps ranked first. The advantages of a virtually unilateral direction of the war in the Pacific were obvious to AAF and Navy leaders, and they were reluctant to accept the disadvantages of large-scale British and Russian participation in the Pacific air and naval wars at such a late date.*

* This is not to imply that the Navy and the AAF saw no advantage in the participation of Russian land forces or objected to the assumption of responsibility by Commonwealth forces for clearing out the Netherlands East Indies.

But the existence of a surplus of aircraft would make it difficult to deny British and Russian requests for planes. Accordingly, the AAF seriously considered cutting production schedules in order to eliminate indicated surpluses. Substantial production cutbacks did occur, beginning in the summer of 1944, but the motivation did not stem solely from this particular source.[26]

In order to strengthen further its control of air materiel in the period after the defeat of Germany, the AAF, through the JCS, secured Presidential approval of a corollary policy concerning lend-lease assignments to nations outside of the Western Hemisphere. Broadened by the JCS to include all munitions rather than only air materiel, the policy stated that

> upon the defeat of Germany, assignment of Lend-Lease munitions will be limited to materials which are not available to the Allied Nations concerned and which are necessary to support that portion of the forces of such nations as, in the opinion of the U.S. JCS, can and will be profitably employed against Japan in furtherance of our agreed strategy.[27]

The July 1944 agreement between the British and Americans allocated 2,546 planes to the RAF for the second half of 1944 and 2,546 for the first half of 1945. As the identity of these figures suggests, it was policy now to provide replacement aircraft only. Further broadening their heretofore somewhat restricted freedom of action in dealing with foreign allocations, the U.S. chiefs of staff reserved the "right to modify allocations of aircraft as military considerations indicate the necessity for such action."[28]

In November 1944 Arnold and ACM Sir Christopher L. Courtney once more reviewed the aircraft situation and agreed that the British would receive 2,280 combat and transport planes (chiefly B-24's, P-51's, and C-47's) from AAF production during the first half of 1945. They stipulated that an inventory should be made in January 1945 with a view to adjusting allocations for 1945. As a result of this inventory, the allocation to the RAF was cut from 528 B-24's to 478 and from 785 P-51's to 605.[29] These were plane types for which the AAF had acute need at the time, particularly for use in the Pacific.

As the end of the European war approached, the American tendency was to reduce allocations still further in order to avoid unnecessary production of items no longer required for prosecution of the war. A survey of RAF and AAF aircraft strengths as of 1 January 1945 disclosed that the former had in its inventory 26,473 first-line combat planes and the AAF had 33,179. Since the unit-equipment

first-line aircraft strengths were 12,488 for the AAF and 7,758 for the RAF, the latter obviously had a higher percentage of reserve strength. The War Department and the AAF felt that this disproportion of reserve strength in the RAF was based largely on the American planes which had been allocated to the RAF over the years, sometimes at the expense of the AAF's expansion. Downward readjustments in British allocations were made during the first half of 1945, and the agreement in June for the second half of 1945 allotted only 654 aircraft to the RAF, 500 of which were used AT-6 trainers. In July the President directed that all lend-lease munitions issued thereafter be limited to those used in the war against Japan.[30] The Japanese surrender in August brought to an end the program of defense aid whereby the United States had played such an important role in supplying its allies with military equipment.

Deliveries generally failed to meet allocation schedules throughout the war because production seldom came up to established goals, especially during the first two years. During 1943, for example, when 79,878 planes had been allocated, deliveries numbered only 68,138. The Russians received 100 per cent of their allocation of 3,431 planes while the AAF received a little more than 80 per cent of its allocation of 56,666 planes and the British almost 90 per cent of their allocation of 9,262.* Even during the first six months of 1945 total deliveries of AAF planes were some 2,500 less than allocations. Among the various recipients the AAF fared best this time, receiving more than 97 per cent of its allocation—20,986 planes of the 21,621 ordered. The Russians received 94 per cent of their allocations and the British less than 70 per cent.[31]

Distribution of AAF Aircraft

The distribution of aircraft within the AAF eventually involved a complicated mechanism which reached from the topmost level of the War Department to the combat unit in the field. The establishment of priorities and the allocation of planes to commands was centered in AAF Headquarters, while the actual distribution was directed and carried out by the Air Service Command and the Air Transport Command. The overseas theaters of operations completed the chain, operating their own systems of allocation and distribution.

Prior to Pearl Harbor the Air Corps did not require an elaborate

* The remainder of the 79,878 planes went to the U.S. Navy or to countries other than those mentioned above.

system for allocating and distributing aircraft, because the relatively small numbers of planes involved permitted effective control direct from OCAC. In July 1939, shortly after the 5,500-airplane program got under way, the Air Corps had 2,400 planes on hand. A year later, when the major expansion began, it had only 3,100 planes. By November 1941 aircraft strength had passed the 10,000 mark, but the most significant increase had been in trainers which at the time constituted almost 65 per cent of the total AAF strength. The number of planes delivered to the AAF for its own use between 1 July 1940 and 31 December 1941 was 9,932, an average of little more than 550 per month. Of this number, 6,533 were trainers, 138 transports, 233 communications planes, and only 3,028 combat planes.[32]

The training planes presented only routine allocation problems because their limited capabilities automatically determined their assignment to training stations in the United States. Transport and communications planes, although in great demand, were few in number and their allocation to a limited number of units was also more or less automatic. But bombers and fighters were the cutting edge of the air force, and their distribution could well affect the security of the country. With only uncertain political and strategic guidance, the Air Corps sought to reconcile immediate demands for combat strength in being with the need to expand its strength to meet the greater demands of the future.

The allocation problem during 1940 and 1941 was essentially one of priorities. The small number of combat planes—an average of one or two deliveries per day during the second half of 1940 and seven or eight per day during 1941—precluded establishment of an automatic system of allocation and supply of aircraft to combat units. The constantly changing situation as to size, number, and kinds of units, types of planes, and diversions of scheduled deliveries required frequent, almost continual, adjustments of priorities and deliveries. The problem was further complicated by the division of responsibility between the Air Corps and the GHQ Air Force. The latter, which controlled the combat units, sought to secure for itself the power to decide when and where the aircraft allocated to it should go, but since the air units in the overseas military departments—Panama, Hawaii, and the Philippines—were not under GHQ Air Force jurisdiction, and since the number of planes available for distribution was severely limited, the Air Corps argued successfully that the allocation function should remain under its control.[33] General Arnold and his planners estab-

lished priorities for equipping groups in accordance with strategic priorities determined by the War Department General Staff. The OCAC Plans Division, and occasionally a committee appointed for the purpose, usually drew up a statement of priorities which was accepted or modified by Arnold personally. Orders would then be issued to the Materiel Division which had responsibility for accepting planes at the factory and turning them over to the pilots sent by Air Corps units to deliver them to their destinations.[34]

Pearl Harbor produced feverish improvisations in deployment of combat units in response to a rapidly changing strategic and tactical situation. In the months immediately following 7 December 1941 aircraft allocations were in a constant state of flux, and the AAF found it extremely difficult to develop a stable system for allocating and distributing its resources. But the enormous demands of the air war produced a huge outpouring of planes from the factories which made mandatory a distribution machine dwarfing anything previously contemplated by the AAF.[35]

Beginning in 1942, the allocation and distribution of AAF aircraft was carried out within a context developed at the highest levels of direction of the war. Decisions on strategy by the heads of government, the CCS, and JCS were followed by deployment priorities set by the JCS. These priorities provided part of the framework within which the AAF determined the allocation of its aircraft resources.

At AAF Headquarters allocation remained centered in the A-3 staff section* under a variety of titles during the whole war. During the first two to two and a half years of the war the great need was for combat planes to equip new units; thereafter, most of the planes were allocated as replacements. On the basis of airplane-availability estimates made by the materiel staff section of the headquarters, A-3 would prepare allocation charts for periods as much as six months into the future. These charts would specify priorities for the various theaters and commands, showing the quantities of allocations by type and model of plane, and by sequence among recipients.† They were

* The Directorate of Military Requirements, which performed many A-3 functions, played a key role in allocations during 1942–43.

† In 1942 the AAF, with the agreement of the British, instituted a block allocation system in place of a fixed monthly allocation to recipients. This system allocated production in the quantity and in the order of approved allocation, by splitting the monthly quotas into blocks (ranging from 5 or 10 planes to 100) without regard to a month-end audit. Under this plan, if 100 B-25's were to be allocated in a given month, the first 20 produced might be for the AAF, the next 15 for the RAF, the

subject to amendment as new priorities were determined in response to military needs.[36]

The distribution of aircraft required the combined efforts of three major commands—Materiel Command, Air Service Command, and Air Transport Command—under the general direction of AAF Headquarters. Once the detailed allocations to units had been determined, AAF Headquarters notified these commands. The Materiel Command issued detailed shipping instructions to its resident factory representatives, and the ATC Ferrying Division undertook to move such planes as would go by air. The ASC received planes at its depots for storage or modification, and directed all overseas shipments of aircraft by water. In July 1943 the Aircraft Distribution Office, directly under the supervision of AAF Headquarters, was established at Patterson Field as a central agency for controlling the movements of aircraft from the factories to their destinations and among air forces in the United States. Apart from the consolidation of functions resulting from the merger of the Air Service Command and the Materiel Command in the summer of 1944, there were no substantial changes in this system of aircraft distribution during the remainder of the war.[37]

The movement of more than 230,000 planes accepted by the AAF between July 1940 and August 1945 was one of the great logistical feats of the war. Most of these planes, probably two-thirds, were ferried to their destinations. The actual number of ferrying flights was considerably greater than the number of aircraft accepted at the factories since planes were often ferried more than once. Many were ferried initially from the factories to modification centers or storage depots in the United States, and subsequently to overseas destinations. Within the overseas theaters they usually made at least one ferrying flight. This was particularly true of replacement aircraft.

During 1940 and 1941 ferrying flights probably had not exceeded 20,000 planes (including those for the British), and almost all of these were within the continental United States.[38] Overseas ferrying of planes was initiated by the British in 1940, when they began flying American-built bombers, including the two-engine Lockheed Hudson, across the Atlantic from Newfoundland to Scotland. The AAF began ferrying some of its planes to overseas destinations in the late summer and fall of 1941, when first a squadron and later a group of heavy

next 5 for China, the next 25 for the AAF and so on. This scheme was the most practicable one because it avoided the disproportion in deliveries which resulted from over- or underproduction during given months.

bombers threaded their way along the Pacific island chain to the Philippines.* But these were pioneering efforts, and the great majority of planes sent overseas during 1940 and 1941 went by water, crated and loaded in the holds of vessels.

In June 1942 responsibility for both domestic and foreign ferrying of aircraft was placed in the hands of the Air Transport Command. This command and its predecessors made 268,000 ferrying deliveries between January 1942 and August 1945, of which 219,000 were to domestic stations and 49,000 to active combat theaters. Approximately 20 per cent of the planes delivered to overseas destinations were lend-lease aircraft for foreign countries. The ATC provided crews for more than 20,000 planes ferried overseas while the remainder of the 49,000 were flown by their own crews. For the latter, the ATC generally provided lead crews for the longer overwater flights. More than 85 per cent of the planes ferried overseas were two- and four-engine bombers and transports, although a number of fighter planes were also delivered via the North and South Atlantic routes.† A total of 594 planes were lost in overseas delivery and 419 went down within the United States.[39]

The development of the overseas ferrying routes by the ATC permitted a greater and much more rapid deployment of American air power than would otherwise have been possible. Most of the medium and heavy bombers were flown to their overseas stations and, all told, more than half of all the planes deployed by the AAF in combat theaters. But this still left a large number, especially of fighter aircraft, to be delivered by water.‡ Despite the fact that water transport was used chiefly for delivery of the smaller models, the difficulties en-

* See Vol. I, pp. 178–82, 313–14.

† For a fuller discussion of ferrying of aircraft during 1941–42, see Vol. I, Chap. 9. Vol. VII of this series will carry the Air Transport Command story through the end of the war.

‡ There is no satisfactory figure for total water shipments of aircraft by the AAF during World War II. Accurate statistics were not kept until early 1943. For the period 1 March 1943–31 August 1945 water shipments amounted to 39,109 planes. An informed but rough estimate places the average monthly shipment of planes by water during 1942 at approximately 240. If one projects this average through February 1943, and includes December 1941, the total would be 3,600 for the fifteen-month period and 42,709 for the whole war. This is, at best, an approximate total. The Statistical Review of the Army Service Forces for World War II lists 47,851 AAF planes as having been dispatched overseas by water between January 1942 and August 1945. It seems clear, at any rate, that the total figure is somewhere between 40 and 50 thousand.

countered presented a major problem, whether measured in terms of the money, man-hours, or time devoted to the effort. The basic problem stemmed from the size and shape of the airplane itself. At best, whether crated or uncrated, it was bulky and difficult to handle, taking up a great amount of space above or below deck on the average freighter. With shipping space at such a premium during World War II, it became necessary to find or devise superior methods of transporting airplanes by water.

Before the war the AAF had considered developing vessels designed specially to carry assembled or partly assembled aircraft to overseas stations in order to increase the speed with which they could be made ready for combat on arrival. In 1940 the Air Corps explored the possibility of building a vessel similar to an aircraft carrier which would carry partly assembled planes both above and below deck and would have a catapult on its prow for launching the planes when they arrived overseas. Aircraft carriers were the most desirable vessels already in existence for carrying planes, but the Navy did not have enough for its own use, and the Air Corps feared that if it built any, the Navy would lay claim to them.[40]

As an immediate aftermath of Pearl Harbor the United States was faced with a critical shortage of cargo shipping which persisted for much of the war period and seriously influenced strategy. Deployment of our own forces and materiel to overseas theaters in accordance with strategic plans, and delivery of arms and equipment to our allies, required an enormous increase in our shipping tonnage. Meanwhile, with the situation rendered still more critical by the German submarine campaign, it was necessary to establish a control of shipping resources which was fully as tight as any other resources control system established during the war.

Dry cargo vessels were the only ships available for movement of aircraft, and they could carry only five or six assembled or partly assembled planes on their decks. Most airplanes, therefore, had to be disassembled and crated for shipment. Crating and uncrating of aircraft were expensive and time-consuming. Deck-loaded aircraft, on the other hand, were easier to prepare for shipment, could be loaded and unloaded more easily, and could be made ready for combat more quickly than crated planes. Consequently, the AAF renewed its effort to find some method of shipment that would make deck-loading possible. The search was intensified as a result of increasing pressure on

the AAF for construction of "knock-down" planes that could be more easily crated, for the adoption of such a device would have required a vast readjustment of production methods at great cost to production schedules.[41]

An AAF suggestion in August 1942 to carry fully assembled aircraft on barges to be towed behind other vessels could not be seriously entertained because convoys containing barges would have been easy targets for the aggressive German submarines. The Services of Supply recommended that the AAF ask the Joint Chiefs of Staff to make available to it a number of the escort carrier vessels being built for the Navy. Since the beginning of the war the AAF had been trying to get some of the Navy's escort carriers to transport planes overseas but had met with consistent refusal on the grounds that the Navy needed all of its carriers for combat or convoy operations. On certain special occasions, notably during the North African campaign, the Navy transported AAF planes by carrier to a combat theater and the planes were flown ashore from the flight deck of the vessel.[42] But understandably the need had to be special in order to justify the diversion of carriers from their regular mission.

In January 1943 General Arnold requested the JCS to arrange for the Navy to release seven escort carriers, or two seatrains* and five escort carriers, to the AAF for transport of planes. Because of the Navy's pressing need for carriers (the antisubmarine war was still at its height), the Joint Chiefs refused the request but indorsed the principle that AAF aircraft should be delivered deck-loaded, either partly or wholly assembled.[43] The demands and uncertainties of combat operations prevented the Navy from meeting the AAF's full requirements for carrier loadings both then and later, but some help came from the British Admiralty which agreed early in 1943 to permit escort carriers being delivered to it in the United Kingdom to carry AAF planes.[44]

Concurrently with its ceaseless efforts to secure additional sources of shipping for its smaller planes, the AAF explored all possibilities of flying its planes to their overseas stations. Since four-engine and many two-engine planes could make the necessary jumps, the critical problem was to move the fighters. During the summer of 1942 the pilots

* Seatrains were ships equipped with railroad tracks onto which railroad cars could be loaded, thereby saving the great amount of time which went into unloading the cars for original shipment and then discharging the cargo and loading railroad cars at destination.

of the 1st and 14th Fighter Groups flew their two-engine P-38's across the North Atlantic to England. A number of replacement P-38's followed in their wake, and before the route was closed for the winter, 179 of 186 P-38's taking off from U.S. bases for Britain had reached their destinations.* Early in 1943 about 50 P-38's flew the South Atlantic to North Africa, and the AAF gave consideration to a proposal to ferry three to four thousand P-38's annually over this route. The 356th Fighter Group flew its P-47's across the North Atlantic to the Eighth Air Force in the United Kingdom in the summer of 1943, but this proved to be the last large overseas air movement by fighter planes, and few if any fighters were thereafter delivered to overseas destinations by air. The Allied success in breaking the back of the German submarine offensive by the summer of 1943, coupled with the tremendous production achievement of American shipyards, made available greater tonnages than had been anticipated. Moreover, the increasing use of tankers as carriers of fighter planes provided still more space. It was clear to the AAF by autumn 1943 that it was more economical and more desirable to ship fighter planes by water than to ferry them to overseas destinations. Once the required shipping was available, plans for flying fighters overseas were dropped.[45]

The successful conversion of tanker decks for transporting planes proved to be the most important development in providing aircraft shipping space. These vessels were available in large numbers and sailed frequently to every theater of operations. The potentialities of the tanker as a carrier of aircraft had long been recognized, and in February 1942 a shipment of A-20's loaded on steel stands welded to the deck of a tanker had been sent to the Russians. During 1942 the AAF considered adoption of this method as the standard means for delivery of its planes, but the Services of Supply, the Office of the Chief of Transportation, the Navy, and aircraft manufacturers opposed it, maintaining that the planes would be seriously damaged in transit. The AAF persisted, however, and in December 1942 equipped a tanker with steel stands, loaded it with P-38's, and dispatched it to the European theater. The experiment was successful enough to encourage more extensive use of this shipping method, and the AAF requested the War Shipping Administration to equip all tankers in the Atlantic with steel stands for carrying P-38's.[46] In April 1943 the JCS

* See Vol. I, 641-45.

directed that the possible use of tanker decks, on which no cargo was being carried, be thoroughly explored.

But the use of steel stands did not prove to be the solution to deck-loading aircraft on tankers because it was necessary to provide a different stand for each type of aircraft, and if a tanker changed from carrying one type of aircraft to another, the stands had to be cut and rewelded to the deck. Accordingly, the War Shipping Administration experimented with superstructures built over the deck of the tanker and finally developed one known as the meccano deck. Partly assembled and processed aircraft were lashed on this deck which was essentially an openwork steel bridge at the level of the catwalk, extending the full length of the well deck from the forecastle to the poop. The immediate success of the meccano deck permitted the AAF to drop consideration of plans for ferrying fighter planes to overseas theaters. In June 1943 AAF Headquarters established the policy that all single-engine and all twin-engine fighter-type aircraft would be shipped by water "insofar as shipping space was available."[47]

During 1943 deck-loading far surpassed crating as the chief method of transporting aircraft on shipboard. In December 1942 the AAF shipped 475 aircraft by water—356 crated and 119 (all P-38's) partly assembled and deck-loaded. A year later, in December 1943, 973 airplanes were shipped by water, of which 130 were crated and 843 partly assembled and deck-loaded. All fighter planes were deck-loaded, the crated aircraft being small liaison (L-4, L-5) and utility (UC-64, UC-78) planes. Tankers carried 60 per cent of the 843 partly assembled deck-loaded aircraft. Finally, between 1 March 1943 and 31 August 1945 tankers carried 17,718 out of a total of 39,000 planes shipped by water.[48]

In spite of this impressive record achieved by the tankers, they did not meet the AAF's full need for assistance. Gasoline and oil, not aircraft, were the primary cargo of the tankers and determined their operations. Aircraft had to be discharged at ports where oil and gasoline were discharged, regardless of the facilities for unloading planes. Unloading of aircraft, which took longer than discharge of gasoline, interfered with the proper scheduling of tankers, and it became necessary at times to place restrictions on the number of tankers which could carry aircraft to certain areas, restrictions which disrupted the processing and scheduling of shipments by the AAF.[49]

Meanwhile, the AAF had been pursuing its goal of securing vessels whose only, or chief, function would be the transportation of air-

craft. In April 1943 the Joint Chiefs had directed exploitation of every possible means of delivering assembled airplanes, and they had specifically indorsed a program for altering cargo vessels for use as carriers of airplanes. The AAF began during the summer of 1943 to press for conversion of C-3-type cargo vessels (Liberty ships) into carriers of airplanes to be known as ZEC-2's. It proved impossible to make the ZEC a vessel capable of carrying fully assembled planes which could be flown ashore, but the AAF came to regard it as the most satisfactory carrier for aircraft. In January 1944 the first successful experiment in loading a ZEC-2 was made, and the AAF requested the War Shipping Administration to allocate twelve of the vessels for exclusive transportation of AAF aircraft and supplies. For the first time it became possible to load partly assembled fighter aircraft below deck.[50]

The AAF received eight ZEC-2's in February 1944 and found them so satisfactory that in April it asked for nineteen more. The first ZEC-2 to carry a full load of aircraft discharged the planes in seventeen hours on arrival in the United Kingdom in February 1944, but conditions there were optimum; at ports where equipment and experienced personnel were limited, unloading took longer. In September the AAF initiated action for further modifying the vessels to permit underdeck storage of the larger fighters—P-38's and P-47N's—whose wing-spans were too great to pass through the existing hatches. Failure to utilize fully the holds of the ZEC-2's might well have caused the vessels to be used for general cargo rather than exclusively as carriers of aircraft. The JCS approved the AAF request, and the latter was allocated sixteen of the nineteen ZEC's it had requested in April, receiving the first only in February 1945 because of the redesign required. Twenty-four additional ZEC-5's (the new designation of the modified ZEC-2's) were to be prepared for delivery in the second half of 1945, but the end of the war put an end to the project. The ZEC's lifted an average load of forty-two aircraft, as compared with approximately fifty-six for escort carriers and fourteen for tankers. Although ZEC's did not begin operations until February 1944, they lifted 7.2 per cent of all aircraft shipped by water between 1 March 1943 and 31 August 1945, and more than 12 per cent of all partly assembled planes shipped during 1944–45.[51]

The chief problem encountered in the use of the deck-loading system was the damage to airplanes caused by corrosion and other hazards. The search for a method which would minimize the effects

of salt spray, weather, and the high seas led eventually to development of special techniques for systematic preparation of planes for water shipment. These included partial disassembly of the aircraft and crating of detached parts, the use of protective devices and anticorrosion preparations on the engines and airframes, and the installation of special fittings and devices to be used in loading and lashing the planes.[52]

The search for protectives which would be equally effective under a variety of climatic conditions, ranging from the blistering heat and tropical rains of the South Pacific to the intense cold and ice of the North Atlantic went on throughout the war. Occasional complaints from overseas, especially the European and the China-Burma-India theaters, of the great amount of work required to clean up badly corroded planes spurred the search for better methods of preparing planes for water shipment.[53] Although the ideal was never fully attained, the degree of success was more than sufficient to warrant continued use of deck-loading for shipment of aircraft.

During the first part of the war deck-loaded planes were covered with cosmoline, a heavy petroleum or grease, but its effectiveness was limited. With the initiation of large-scale shipment by tankers in 1943, there was a need for a more satisfactory anticorrosive, and paralketone was developed. This heavy petroleum derivative proved moderately successful, especially in cool and cold weather and was therefore especially useful in the Atlantic. Its chief deficiency was the difficulty encountered in removing it. Continued experimentation led to development of a plastic coating* which was first used in November 1943. Adopted for standard use in 1944, it remained the chief means of protecting deck-loaded planes from the elements for the remainder of the war. The chief advantage of the plastic coating was that it required only 3 to 4 man-hours to peel off, compared with 200 man-hours to remove paralketone. In spite of its decreased effectiveness as a protective device during winter weather, the plastic coating was used on more than 10,000 of the 14,000 processed aircraft shipped overseas during 1944.[54]

Processing and deck-loading aircraft was also more economical than crating them, according to a study made in March 1944. The cost of transporting and delivering the processed plane was only \$890, compared with \$1,357 for the crated plane. The processed plane also

* These plastics had a variety of trade names, including Eronol and Plastiphane.

weighed less and required less floor space than the crated plane. It used more cubic footage, but since this was on deck rather than in the hold, it was less significant than the other factors.[55]

The Final Test

The final test of the AAF's logistical system was the extent to which it provided the means with which to fight a global air war. The remarkable growth of the Army air arm's combat strength after 1941 is suggested by the following table:[56]

Airplanes on Hand in AAF (by Major Type)

End of Year	Total	Heavy Bombers	Medium and Light Bombers	Fighters	Reconnaissance Planes	Transports	Trainers	Communications
1939	2,546	39	738	492	378	131	761	7
1940	3,961	92	639	625	404	124	2,069	8
1941	12,297	288	1,544	2,170	475	254	7,340	226
1942	33,304	2,079	3,757	5,303	468	1,857	17,044	2,796
1943	64,232	8,118	6,741	11,875	714	6,466	26,051	4,267
1944*	72,726	13,790	9,169	17,198	1,804	10,456	17,060	3,249
Aug. 1945	63,745	13,930	8,463	16,799	1,971	9,561	9,588	3,433

* In July 1944 the AAF reached its peak of 79,908 aircraft on hand.

The number of first-line combat airplanes on hand was, of course, much less than the total number of planes on hand.* Because more than half of the 1941 production of first-line combat planes went to our potential allies, chiefly the British, the number available for the AAF was small. First-line combat strength rose rapidly from 1,599 in September 1941 to 4,000 in December 1941, when the desperate need for planes caused the definition of first-line to be somewhat broadened and when the AAF took possession of a large number of planes awaiting shipment to the RAF. By the end of 1942 the number of first-line combat planes had grown to 10,885, increasing thereafter to 23,807 at the end of 1943 and to 33,179 at the end of 1944. At the end of August 1945, when the European war had been over almost four months, the AAF still had a first-line combat strength of 31,235 planes.[57]

But it was overseas strength which eventually determined the outcome of the air war, and here the AAF build-up was slow until well along in 1943 when the aircraft production and combat-crew training programs began to approach their peaks and the required shipping became available. The phenomenal build-up of American overseas strength from 1943 forward is indicated by the following table:[58]

* First-line planes are those considered capable of performing the mission for which they were originally designed and thus are distinct from planes no longer capable of performing their original mission because of age or obsolescence.

*Overseas Combat Aircraft Strength of the AAF**

End of Month	*Total Combat Planes Overseas*	*First-line Combat Planes Overseas*
Nov. 1941	1,024	870
Dec. 1941	1,105	957
June 1942	1,998	1,902
Dec. 1942	4,798	4,695
June 1943	9,001	8,586
Dec. 1943	12,719	11,917
June 1944	20,814	19,342
Dec. 1944	22,876	19,892
Apr. 1945	24,122	21,752
Aug. 1945	17,315	15,100

* These figures include planes en route, so that effective strength on hand was actually somewhat less than shown in the table.

Still another measurement of the over-all achievement is provided by figures on the deployment of combat units overseas:[59]

AAF Combat Group Strength

End of Month	*Total*	*Overseas**
December 1941	67	18
June 1942	114	29
December 1942	167	69
June 1943	234	103
December 1943	269†	135
June 1944	234	203
December 1944	242	214
April 1945	243	224
August 1945	213	155

* Since this figure includes groups en route, the actual number on hand was usually less than shown here.

† The peak number of combat groups organized was 269, but this includes many paper units. In January 1944 the number was cut back to 218, rising thereafter to a maximum of 243 in 1945. Most of the increase was accounted for by new B-29 groups.

The biggest build-up of strength came during the first half of 1944 when sixty-eight combat groups moved to overseas theaters, most of them to the Eighth and Ninth Air Forces in the United Kingdom, where the invasion of western Europe would be mounted. The peak strength of 243 groups, of which 224 were in overseas theaters, was reached in April 1945. Thereafter both the total and overseas strength declined as the defeat of Germany reduced requirements for combat units.[60]

SECTION III

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RECRUITMENT AND TRAINING

CHAPTER 13

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BROADENING THE BASIS OF PROCUREMENT

IN THE preceding section of this volume attention has been directed to the problem of providing equipment in sufficient quantity and quality for the use of combat forces operating on schedules determined by over-all strategy. In these chapters the focus falls upon the parallel problem of recruitment and training. Though the order in which the two topics are presented is intended to suggest the fundamental importance of the machine to air warfare, it should not be assumed that the task of providing skilled manpower can be regarded as in any way of secondary significance. Indeed, the superior qualities of a given aircraft may be more than offset by the inferior skill of the man who flies it, and it can well be argued that the AAF's training program was its outstanding achievement on the home front. Although the AAF provided a necessary leadership in the development and production of aircraft, it had at its command the vast resources of a highly industrialized nation and could at critical points depend heavily on other organizations, military and civilian. But the task of training thousands of young men in the highly specialized skills required for military aviation was one that was borne entirely by the limited resources of the Air Corps itself.

How limited those resources were at the outset, and how great the demands made upon them, is quickly suggested by the contrast in two sets of figures. On 30 June 1938 Air Corps strength was only 20,196, a figure which represented 11 per cent of the total strength of the United States Army.[1] Six years later the Army Air Forces had 2,372,292 commissioned officers and enlisted men, and that total represented 31 per cent of the huge army recruited to fight World War II. A marked feature of this tremendous growth was the increase which, at

its peak in May 1945, gave the AAF 388,295 commissioned officers on active duty.[2]

The Air Corps before 1939 had been a small, close-knit organization bound together as much by the enthusiasm of its members for the airplane and for flying as by any other consideration. Depending upon volunteers for recruitment, it had many of the qualities of an elite corps. Flying training was centered in the region of San Antonio —mother-in-law, it was commonly said, to the Air Corps. There, where good flying weather prevailed, three fields served to base the Air Corps Training Center: Kelly, Brooks, and Randolph, the latter developed after 1928 and highly publicized as the "West Point of the Air." In no year prior to 1939 did its flying cadet graduates number more than 246, and in only four years did the total exceed 200.[3] Since Air Corps strength was rigidly limited by legislative and budgetary restrictions, all but a very few of these graduates received their commissions in the Air Corps Reserve. After a tour of duty with a tactical unit that might last from six months to two years, they returned to civilian status. Many of them found employment with the civil airlines.

Even after the President's expansion program had begun to affect the strength of the Air Corps, it remained at the beginning of the European war in September 1939 a small force. Its regular officer strength at that time was 2,058 to which were added 669 reserve officers on extended active duty. Enlisted strength was 23,779.[4] In all components of the Army there were 4,502 officers who had qualified as pilots; of this number 2,187 were reserve officers and 308 were in the National Guard. The Air Corps had fewer than 50 officers of high rank: 2 major generals, 8 brigadier generals, and 39 colonels. Of the regular officers, almost half were in the grades of captain and first lieutenant.[5] The GHQ Air Force, which assumed the major responsibility for all advanced training in addition to its defensive obligations, had just over 1,000 officers and some 7,000 enlisted men.[6]

To train a variety of technical specialists, the Air Corps Technical School at Chanute Field in Illinois gave instruction in such subjects as mechanics, communications, photography, and armament, with the last two departments recently transferred to the newly developed Lowry Field near Denver, Colorado. Basic military training for the new recruit was considered a mere preliminary to all other training and was given usually by the organization responsible for later phases. To develop the more advanced skills required by Air Corps mechan-

ics, heavy dependence was placed upon "on the line" training, which is to say that the men learned their jobs by working under the supervision of more experienced men. The only postgraduate course of study was given in the Air Corps Tactical School at Maxwell Field in Alabama, where officers on special assignment to the school got instruction not only in tactics but in other subjects, such as air doctrine, pertinent to staff work. If one may judge by the product, Air Corps training programs were good, but they were also wholly inadequate for the great expansion brought about by the war.

Not only were the numbers to be trained greatly increased after 1939, but the raw material itself was basically different. Though for some time yet the Air Corps was in position to depend upon volunteers and was fortunate in drawing perhaps more than its share of the more promising recruits, the motivation of the new volunteer was quite unlike that of the old. Under the pressures of a national emergency, he had chosen the Air Corps in preference to service in the Army or the Navy, and not because of the appeal to him of a career in the air service. He was, in short, as much a citizen soldier as were most of the others then entering the armed services. To fit Air Corps training to his particular needs and psychology would require many adjustments in the traditional pattern.

The Air Corps was fortunate in the priority accorded its claims on the available manpower resources of the country. Those resources, it should be remembered, were by no means unlimited, and the number of men of military age who combined the physical and educational qualifications considered requisite for flight training was comparatively small. That number was further reduced, in terms of those available for use by the Air Corps, by the competition offered by opportunities in other arms and services, especially the Navy and Marine Corps. But so fundamental to plans for strengthening national defense was the prewar program for Air Corps expansion that it was given preference over all other parts of the Army in the recruitment of personnel. Even after the attack at Pearl Harbor had precipitated full-scale mobilization, the AAF carried so large a share of responsibility for early defensive and offensive action that it got continued support for its claim to preferential treatment. Through 1942 men of draft age might by voluntary induction choose their own branch of the service, a policy which operated overwhelmingly in favor of the AAF; and thereafter it still enjoyed an advantage over the ground and service

forces. During 1943 over 41 per cent of the men falling into the two top classes, according to the Army General Classification Test, of those processed and assigned at reception centers went to the AAF.[7]

AAF requirements at all levels emphasized the need for special aptitudes or for special occupational skills. Its operations depended upon one of the more complex products of the machine age, and the men who serviced the airplane as well as those who flew it necessarily had to represent in some degree the intelligence of the society which produced it. But the most critical problem was that of procuring and training aircrews. Experience would show, as has been suggested in preceding pages, that there were many opportunities to copy industrial mass production devices that would permit the effective employment of unskilled or semiskilled men, but the pilot who flew the plane had to be trained to standards that permitted little compromise. Personnel objectives during the great expansion were commonly stated, and are most easily followed, in terms of the programs successively established for pilot training.

Pilot Programs

In the fall of 1938, when plans for the initial expansion were being shaped, General Arnold called to his assistance at Washington many officers who subsequently gained distinction in the war. Among them were Carl Spaatz, Joseph T. McNarney, and Ira C. Eaker, but none was destined to carry a heavier responsibility than did Brig. Gen. Barton K. Yount, upon whom fell the heaviest obligation for the development of the AAF's training program. At the time of his call to Washington he was serving as commandant of the Air Corps Training Center; from January 1942 to July 1943 he headed the Flying Training Command and thereafter the tremendous educational venture of the AAF Training Command. Having been relieved of his duties at Randolph, General Yount in January 1939 assumed the leadership of a "training group" in OCAC which included Col. Gerald C. Brant, who had commanded the Air Corps Technical School, and Col. Rush B. Lincoln, who subsequently served as commanding general of the Technical Training Command.

In planning the new program the closest attention had to be given questions of balance. The President's promise of additional planes could have little practical value for the Air Corps without trained crews to man them and without the facilities necessary for their em-

ployment. The expansion of training would in itself require additional facilities, just as the manning of those facilities would impose new requirements on the training program. This training program, moreover, would present its own special requirement for aircraft, a demand necessarily affecting the percentage of total aircraft production that could be allotted to combat units. However considered, the shaping of a balanced program with provision for the proper synchronization of its several parts was difficult enough. But it became still more difficult because no single program of expansion was to be completed before world events compelled the adoption of yet another and larger project.

Although the objective in each instance was set in terms of a specified number of combat-ready units, particular parts of any program might conveniently carry their own separate designation. Thus the 24-group program of 1939, first in the series, tended to be known among those offices which were primarily concerned with recruitment and training as the 1,200-pilot program. After Congress in April 1939 had authorized for the Air Corps a total strength of 3,203 officers and 45,000 enlisted men, the War Department approved an Air Corps plan for a force of 24 groups by 30 June 1941. To achieve this goal it would be necessary for pilot training to be stepped up to a rate of 1,200 graduates per year, and for the training of enlisted technicians to be advanced from the estimated 1,500 graduates in 1939 to 9,000 in 1940, and by 1941 to a rate of 30,000 annually.[8] Whether one talked of 24 groups, 1,200 pilots, or 30,000 technicians depended on the job in hand.

The 24-group or 1,200-pilot program, which officially was dated 1 July 1939, served to guide the Air Corps' expansion for less than a year. Growing concern over the world situation produced in the spring of 1940 a new 41-group program calling for a training rate of 7,000 pilots per year. This 7,000-pilot program, submitted to WPD on 28 March 1940 with a schedule for completion by 31 December 1941, specified an Air Corps strength of 7,137 officers and 94,415 enlisted men.[9] War Department authorization to proceed with the new program had hardly been received when the startling success of the German invasion of France precipitated a new flurry of planning. Consequently, the 41-group program served chiefly to ease the transition to a still more ambitious 54-group program in the summer of 1940.

This program, also described as the First Aviation Objective, estab-

lished a pilot-training goal of 12,000 cadet graduates per year.[10] The new rate had not been set without some discussion as to the immediate need for so high a figure. Over-all plans called for a force of 4,000 combat planes by December 1941, by which time it could be expected that the 7,000-pilot program would provide a sufficient number of pilots for a force of that size. It could be argued that a more gradual move toward a higher rate of training would be more economical, an argument that is understandable enough at a time when the nation was still a year and a half away from actual involvement in the war. But Arnold countered, in a memo of 23 June 1940 to G-3, with a characteristic view: "*Such economy is obtained by the irretrievable loss of time*." An immediate shift to the higher objective, he admitted, would advance the date for completing the 4,000-plane force by less than two months—specifically, to 20 October instead of 15 December 1941. But it took from six to nine months to provide additional facilities for any expansion of training and, after the necessary facilities had been added, it would take another seven and a half months to train the first pilot. Nor were facilities the only factor imposing an unavoidable delay upon the realization of any new training goal. Training could be conducted only if the necessary planes were available, and this called for advance planning to fit the requirement into a tight production schedule. Moreover, any expanded pilot-training program increased the demand for service personnel, whose training in itself took six months to complete. Everything considered, Arnold concluded that it required "a year to augment the training facilities before any appreciable augmentation in the number of trainees can be obtained."[11]

By March 1941 a still more ambitious program, calling for 84 groups, boosted the objective in pilot training to 30,000 a year and the rate for enlisted technicians to 100,000.[12] This was the official program on which the AAF was working when war came in the following December, but in September 1941 the ultimate goal had been placed even higher in one of the more significant documents of the war period. Prompted by the passage of the Lend-Lease Act, the War Department in the spring of 1941 had begun a more systematic study of national resources available for war than had yet been undertaken, a study which provided the basis for the Army's section of a Joint Board Estimate of United States Over-all Production Requirements submitted to the President in September 1941.[13] The AAF presented its own separate estimates for inclusion in the Army section of the

report through a document which carried the serial designation AWPD/1. Based on the assumption that Germany would be the principal foe and that the AAF would mount a major strategic bombing offensive against Germany, AWPD/1 proved to be a remarkably accurate forecast of requirements for the accomplishment of missions actually undertaken by the AAF during the war.

The War Department had estimated that the total pool of able-bodied men available for service in the Army stood at 8,795,658.[14] Of this total the AAF claimed over 2,000,000.[15] Computing its requirements first for an interim air force that would operate with existing equipment or with aircraft soon to be available, and secondly for eventual needs in the use of aircraft that should be ready by 1944, the AAF broke down its estimates for officers as follows:

	Interim	*Eventual*
Pilots	90,391	103,482
Navigators	19,866	21,462
Bombardiers	8,125	7,387
Observers	3,195	3,195
TOTAL	121,577	135,526

The estimated need for nonflying Air Corps officers was presented as 39,214 and 40,798, respectively. These figures brought the totals for the Air Corps to 160,791 and 176,324. In addition, it was estimated that the AAF would need officers commissioned in other branches to the number, first, of 18,607 and later 19,355. The grand totals thus came to 179,398 and 195,679. For enlisted men the figures were:

	Interim	*Eventual*
Technicians Air Corps	813,951	862,439
Non-Technical Air Corps	588,267	614,403
Total Air Corps	1,402,218	1,476,842
Other Branches	479,503	492,395
TOTAL	1,881,721	1,969,237

The grand totals for both officers and men stood at 2,061,119 and 2,164,916. To meet these goals it was estimated that pilot training would have to reach a rate as high as 85,236 per year, and that as many as 72 schools would have to be provided over and above those required for the 30,000-pilot objective.[16]

Although the AAF recruitment and training programs would not be geared to any such objectives as these until after the nation was

actually at war, projects already authorized proved to be heavy enough. Past experience indicated that only one out of every five applicants for flying training would be able to meet the high physical and mental qualifications, and that of those accepted no more than 40 to 50 per cent could be expected to finish the course. Procurement objectives accordingly came to be fixed at figures double those used to designate the several programs, as may be seen in the following table:[17]

Program	*Annual Graduation Rate of Pilots*	*Number of Students To Be Entered Annually*	*Number of Applications Needed*
24-group	1,200	2,200	12,000
41-group	7,000	14,000	70,000
54-group	12,000	24,000	120,000
84-group	30,000	60,000	300,000

Eliminees from the pilot-training program would not be lost to the Air Corps, for they could be used to fill its requirements for bombardiers and navigators. These requirements were fixed with reference to pilot goals at a ratio of one to five and one to three, respectively.[18]

To clear the way for recruitment on any such scale as this, it was necessary to seek special legislative aids from Congress. In the summer of 1940 Congress suspended a legal limitation that restricted the number of flying cadets in any one year to 2,500. A second obstacle to Army Air Corps procurement was eliminated in June 1941 when the pay, allowances, and insurance privileges of Army flying cadets were placed on a par with those established for the Navy and Marine Corps,[19] thus ending a discrimination favorable to the other services just in time to prevent the Army recruiting program from bogging down. The legislation also substituted the grade of aviation cadet, Army Air Corps, for the grade of flying cadet, a grade that had been created on 11 July 1919 to permit the payment of flying pay to pilot trainees during the hazardous instructional period. The new grade embraced, in addition to those engaged in pilot training, students in such nonflying specialties as engineering, meteorology, armament, communications, and photography, and thus made it possible to avoid a loss of status by those eliminated from pilot training for transfer to other programs.[20]

As procurement objectives rose, new sources from which to obtain the necessary personnel had to be tapped. The high physical and mental qualifications required for appointment to aircrew training were severe limitations. Although physical standards were not altered, their interpretation was eased considerably by such devices

as granting waivers, and the percentage of candidates disqualified for physical reasons declined from 73.2 per cent in 1939 to 50.3 per cent in 1941.[21] The educational requirements—two years of college or passing a difficult examination—were more formidable obstacles in the path of many otherwise qualified men. Consequently, the examinations were modified to make it easier for a greater number of applicants to qualify by passing the educational test.[22] In addition, local and state boards of education and, particularly in the summer and fall of 1941, many colleges sponsored "refresher courses" to help candidates prepare for the examinations. Junior chambers of commerce and the American Legion were also active in promoting special courses of instruction and in securing the cooperation of educational institutions. Such review courses, coupled with the modification of the educational examination, greatly increased the manpower pool from which personnel could be procured for flying training. In the fiscal year 1941 9,272 took the educational examination. From July to December 1941 twice as many candidates took the examination as had applied for it during the preceding year.[23]

Meanwhile, the Air Corps was put under considerable pressure by the War Department to substitute a high school diploma for the two-year college requirement.[24] An editorial in the New York *Daily News* entitled "Rickenbacker Didn't Go to College," was indicative of the feeling on the part of a segment of the population. Questioning the desirability of college experience as a prerequisite for pilot training, the newspaper recommended:

> We move that these college requirements be discarded and that our flying forces be permitted to pick their material wherever they can find good material. The object, in building up our fighting equipment, is to get planes that can fly better than anybody else's planes, driven by pilots that can pilot and air fight better than anybody else's pilots. The possibility that we may pick up some pilots who don't know a cosine from a dodecahedron, or the proper way for a gentleman and an officer to navigate a teacup, is of very minor importance. We bet there are a lot of taxicab drivers who could be turned into swell combat pilots.[25]

While conceding that such a step would widen the field of potential trainees, the Air Corps opposed it on the ground that aviation cadets were prospective commissioned officers and leaders; therefore, certain cultural and educational prerequisites were important. However, in order to forestall further pressure while also widening the supply of manpower available for assignment to flying training,

plans were made to give flying training to enlisted men who did not meet the educational requirement. The Air Corps plan called for training in an enlisted grade, as soon as legislation would permit, 20 per cent of the total number of pilots required. The necessary law was enacted on 3 June 1941, simultaneously with the passage of the aviation cadet bill. Enlisted men in the Army could now be detailed for training as aviation students in their respective grades, but the regulations differed from those for aviation cadet training with respect to age, education, and disposition upon graduation. The age limits were eighteen to twenty-two, instead of twenty to twenty-seven. A candidate had to be a graduate of an accredited high school, be ranked in the upper half of his class, and have at least one and a half credits in mathematics. After completing pilot training, the student was to be given the grade of sergeant pilot. Brig. Gen. George H. Brett, Acting Chief of the Air Corps, told a Senate committee that the Air Corps contemplated using these men as primary flight instructors, probably as basic flight instructors, as utility pilots, and as pilots of troop and cargo transports.[26] The first group of enlisted students entered training on 23 August 1941.[27]

The pool of manpower available for flying training was further augmented in the summer of 1941 when provision was made for the training in grade of officers of the Army of the United States. Previously, only Regular Army officers had been eligible for training in grade, and Army regulations had required that all other officers train in the grade of flying cadet and then accept the rank of second lieutenant in the Air Corps Reserve, regardless of the rank held before.[28] Not surprisingly, the number who sought the training was very small. Legislation authorizing reserve and National Guard officers to take pilot training in grade was enacted on 3 July 1941. The first class of officers training in grade entered primary flying school in November 1941.[29]

Procurement of personnel from military ranks had increased with the passage of the Selective Training and Service Act in September 1940, and its extension in August 1941, together with additional legislation passed that year, added substantially to a manpower pool upon which the Air Corps could draw. Each successive increase in Army strength made the military pool a progressively more important source from which to draw pilot trainees, whether as aviation cadets, aviation students, or officers training in grade. By the time the United

States entered the war, 25 to 35 per cent of the total number assigned to flying training were coming from military sources. The class of 20 December 1941, for example, was composed of men in the following categories and proportions: enlisted men assigned to training as aviation cadets, 27 per cent; enlisted men assigned as aviation students, 8 per cent; Regular Army officers and officers of the Army of the United States assigned to flying training in grade, 2 per cent; and aviation cadets assigned directly from civilian life, 63 per cent.[30]

The bulk of recruits obtained from civilian sources in the pre-Pearl Harbor period were college students. The Air Corps consistently maintained that men with at least two years of college training were the most desirable personnel in terms of health, intelligence, and general background. Recruiting drives and publicity during this period were therefore aimed directly at this particular group, and procurement machinery was used to promote an increased interest in flying training at the college level.[31]

Recruiting Procedures

Responsibility for recruiting personnel for the Army was theoretically a function of The Adjutant General. Prior to the expansion of the Air Corps, however, procurement of flying cadets had largely devolved upon the OCAC. Since the college men whom the Air Corps wanted to enroll as flying cadets were rarely attracted by normal recruiting methods—routine advertising on billboards, poster displays in front of post offices and federal buildings and in the seamier districts of cities—the Air Corps had to resort to special techniques, both official and unofficial. The official method was to have The Adjutant General write letters to the presidents of the leading colleges and universities, especially those with ROTC units, requesting that the Air Corps flying program be brought to the attention of their students. In other instances regular Air Corps officers, through personal contacts, urged promising engineering students to seek a flying career. The Air Corps also secured personnel for its cadet program through the intercession of prominent civic and professional leaders—members of Congress, newspaper editors, lawyers, and Army officers—who sought appointments for their "bright boy" protégés.[32]

Once the prospective candidate became interested in the Air Corps

program, he submitted an application, with supporting papers, for appointment as a flying cadet directly to The Adjutant General who forwarded it to the OCAC. If the OCAC approved, the applicant was authorized to appear before one of the twenty-eight flying cadet examining boards located at Air Corps stations and posts in the United States and in certain overseas possessions (one board each was established in the military departments in Hawaii, Panama, and the Philippines). The examining boards passed initial judgment on the physical, mental, character, and personality qualifications of applicants, and the results of this examination were forwarded to OCAC for final determination of the candidate's qualifications. If the applicant was accepted for pilot training, his name was placed on an eligible list which was arranged in accordance with a system of priorities established in 1928.* Because the number of qualified applicants before 1938 was always greater than the authorized quotas, OCAC had been able to exercise its prerogative of picking outstanding college graduates.

* List of priorities for appointment to flying cadet status in Army Air Corps:

a. (1) Graduates of the United States Military Academy, the United States Naval Academy, and the United States Coast Guard Academy who apply for appointment as flying cadets within 1 year from date of graduation, who fail to receive commissions because of lack of vacancies and are recommended for appointment as flying cadets by the respective superintendents of those academies.
(2) Enlisted men of the Air Corps of the Regular Army who at time of appointment have served at least 11 months.
b. Other enlisted men of the Regular Army who at time of appointment have served at least 11 months.
c. Officers and enlisted men of the National Guard who at time of appointment have been assigned to Air Corps units for at least 11 months and who are favorably recommended by their commanding officers.
d. College graduates who are graduates of the Air Corps Reserve Officers' Training Corps units.
e. College graduates who are graduates of Reserve Officers' Training Corps units of other arms or services.
f. Graduates of recognized colleges and universities.
g. Other officers and enlisted men of the National Guard who at time of appointment have had at least 11 months' service.
h. Students in Air Corps Reserve Officers' Training Corps units who have completed their junior year.
i. Reserve officers and members of the Enlisted Reserve Corps who at time of appointment have served at least 11 months.
j. Students in good standing of recognized universities who have completed their sophomore year.
k. Others.

See *Flying Cadets of the Army Air Corps* (1937), pp. 10–11, as cited in USAF Historical Study No. 15, Procurement of Aircrew Trainees, p. 4.

In 1938 certain changes in recruiting policy were instituted. In the first place, it was decided to decentralize procurement from the office of The Adjutant General to corps area headquarters where applications for flying cadet examinations were henceforth received. Although the decentralization was necessitated by the impending expansion of the Army, the processing of a flying cadet application now became a slow and often confusing business. The prospective trainee was required to submit to the recruiting officer in his district a properly filled out application form, supported by three letters of recommendation from citizens of prominence in his place of domicile, legal evidence of his place and date of birth, and a registrar's certificate of college or university credits. Those who did not have the two-year college background had to pass a difficult examination prepared and graded by the department of ground training at Randolph Field. Since parts of the examination consisted of essay questions, grading the papers was slow and delays were inevitable. When these details were out of the way, the next step was for the candidate to appear before a flying cadet examining board. The applications and allied papers of those approved by the boards were then forwarded through recruiting channels to the OCAC which made a recommendation to The Adjutant General. Those applicants favorably recommended were appointed flying cadets by the War Department. Those who received appointments were then ordered by their corps area commander to report at the Air Corps Training Center on a given date to start training.[33] Every corps area was made responsible in 1938 for furnishing a minimum number of qualified candidates for each training class. Corps area quotas were derived from existing training requirements and the character and extent of population in each corps area. These quotas rose sharply in 1939 and 1940 as the expansion program got under way. Procurement now became dependent largely on the interest and energy displayed by individual corps area commanders, acting under the general supervision of The Adjutant General.[34] But the successful development and completion of successive expansion programs depended ultimately upon the initiative of the Chief of the Air Corps. His was the primary interest, and upon his influence in the War Department depended the direction recruiting efforts would take and the pressure that would be put behind them.

His influence was especially important in the development of an

intensified program of publicity in support of the recruiting campaign. Although there had been little need for elaborate publicity in order to fill the limited quotas of recent years, and although it may be true, as Maj. Gen. Frank M. Andrews charged in 1937, that the Air Corps had failed to exploit fully existing opportunities for favorable publicity in support of its objectives,[35] this was nevertheless an area of activity for which airmen long since had shown a certain proclivity. It had also been repeatedly demonstrated that the public in general was receptive to Air Corps publicity. With the focus of the whole program for strengthening national defense concentrated so sharply on the role of the airplane, it could be expected that Air Corps advertising would reach an audience even more receptive than usual.

Nation-wide publicity was handled through the Appointment and Induction Branch of The Adjutant General's office and by the War Department Bureau of Public Relations, with active cooperation from the Chief of the Air Corps. Printed recruiting material was distributed from the Recruiting Publicity Bureau headquarters at Governor's Island, New York. The War Department also furnished weekly radio transcriptions, and local stations augmented this service with announcements of interest to their particular audience. Interest in flying training was also fostered through newspaper and magazine advertisements and by the use of films, window displays, and other exhibits. Local publicity, the responsibility of corps area commanders, was supervised and conducted by corps area public relations and recruiting officers, assisted at lower echelons by district and local recruiting representatives. Pamphlets and posters were given general distribution. Feature stories and information about enrollment, appointment, departure, and training activities of local residents were supplied to newspapers in the corps area. When the time came for the cadet to receive his commission, a special article accompanied by a photograph was sent to his home-town newspaper. Thus in story and picture the Air Corps sought to glamorize the life of the flying cadet.[36]

While top echelon officials and corps area commanders were all directly or indirectly concerned with publicity for procurement and recruiting, prospective candidates came into actual contact with members of the regular flying cadet examining boards. The number of these boards increased from twenty-eight to over fifty in the

pre-Pearl Harbor period. Administratively, they were under the supervision of corps area commanders although actually located at Air Corps stations. These regular boards had occasionally been supplemented in certain corps areas during the period from 1936 to 1938 by traveling examining boards which were equipped both to disseminate information and to examine applicants on the spot. The success of these early ventures, particularly in reaching colleges not located so as to be conveniently serviced by the regular boards, led to the use of mobile boards to cover colleges throughout the entire United States. When means of intensifying recruiting were discussed with General Arnold in the fall of 1937, he had recommended that five traveling boards—each composed of a pilot, a flight surgeon, and two assistants—be dispatched to canvass the nine corps areas. In January 1938 specific authority was granted by The Adjutant General to the commanding generals of the Second, Fourth, Fifth, Eighth, and Ninth Corps Areas to appoint boards to visit as many colleges and universities as could be surveyed satisfactorily within a two-month period. The president of each board was instructed to coordinate his plans with the respective corps area commanders so that no conflict or duplication in the recruiting effort would arise.[37]

The boards started on tour in the spring of 1938 and visited sixty-three colleges and universities located from coast to coast. These visits were well staged. A board, wherever possible, arrived by plane, an event usually well covered by the student newspaper, and the presence in the community of Air Corps pilots usually was enough in itself to evoke a certain interest and enthusiasm. The approach to the students, whether by formal address before a general assembly or otherwise, was one of offering information on opportunities open to qualified applicants; the boards were so constituted that they could review the qualifications of interested students on the spot and before enthusiasm might wane. The results were so gratifying that the experiment was repeated in the spring of 1939 when fifty-four campuses were visited. In the first year 485 examinations were authorized and 388 candidates qualified for flying training. On the second tour 2,369 examinations were authorized and 406 candidates qualified. Concurrently, regular boards examined 4,556 applicants and qualified 836 in 1938, and examined 2,240 and qualified 571 in 1939. The success of the traveling boards in tapping the best material available for flying training guaranteed their continued existence, and dur-

ing the spring drive of 1940 the number of boards was increased from five to eighteen, two being assigned to each corps area. The increased number of boards made for a greater flexibility in schedules, and the Air Corps got a wider coverage of potential candidates. Traveling boards examined 2,726 candidates and qualified 733 between April and June of 1940, while regular boards qualified 670 out of 1,935 applicants. Under the pressure of mounting procurement objectives, the scope and activity of these boards were considerably expanded in the year and a half before Pearl Harbor. They operated continuously, and although the primary emphasis of the traveling boards continued to be on colleges and college towns, they also visited cities not conveniently served by regular boards, and Army posts, where men who had been drafted were enabled to apply for flying training. By the time the United States entered the war, traveling boards were obtaining the majority of cadets procured.[38]

The Army also received generous cooperation from many civilian groups during its drives to recruit flying cadets. World War I pilots and aviation enthusiasts among the membership of such agencies as the American Legion, the Veterans of Foreign Wars, junior chambers of commerce, and fraternal organizations made substantial contributions. Their officers and leaders made public addresses, appeared on radio programs, lent their support to special demonstrations and exhibits, and supplied material for feature newspaper articles—all with the purpose of making the public aware of the Air Corps and its needs. After the adoption of selective service some of these auxiliary organizations proved very useful in working with local draft boards to screen out young men having the special qualifications desired by the Air Corps. To committees established by the American Legion, draft boards often furnished the names and addresses of those men classified I-A who possessed the educational qualifications for Air Corps training. The men were then approached by the committee and advised of the advantages of enlisting in the Air Corps for cadet training. Eventually, the Selective Service Systems itself gave official recognition to procedures whereby, after 15 September 1941, lists of I-A registrants were submitted to recruiting headquarters of the state thirty days before induction notices were mailed. In the interim, recruiting officers were given freedom to solicit these registrants for aviation cadet training.[39]

Other groups, such as the American Flying Services Foundation,

sponsored projects to rehabilitate men previously rejected for flying training because of slight physical disabilities. Even the General Federation of Women's Clubs, through its aviation committee, gave substantial aid to procurement by organizing an educational program to acquaint mothers with the need for flying cadets and to overcome the fears of those who might have sons interested in a flying career.[40]

A novel scheme to meet the rising procurement goals was hastily launched in the spring of 1941 to counter the anticipated effect of a Navy program for recruitment of flying cadets in the colleges.[41] Young men who had attended the same college or who resided in the same city were advised that they could form themselves into flying cadet units of approximately twenty men, be assigned in a body to the same elementary pilot training school, and continue together insofar as possible through later stages of training. The scheme promoted competition between individual college units, between one college and another, and between neighboring cities; it was an excellent source of publicity; and it increased the flow of promising cadets. Air Corps stations detailed young Air Corps officers to assist corps area recruiting officers in organizing the units. These officers spoke before fraternity groups, college assemblies, and to public gatherings; they secured prominent campus figures and well-known young men associated with civic enterprises to act as organizers and leaders of the flying cadet units. By continual publicity the Air Corps built up among units a lively competition which multiplied the number of applications, and as a result the units were rapidly brought up to the desired strength. All applications were sent directly to corps area authorities, each plainly marked with the name of the college and the number of the unit to which the candidate belonged. Because more efforts were concentrated on the colleges than on cities, twenty-six colleges and universities had reported the formation of one or more flying cadet units by 10 June 1941 when completion of the first city unit was reported by Pittsburgh. The entire program had proved so popular and rewarding that the OCAC suggested in July 1941 that various civic and patriotic organizations be allowed to sponsor flying cadet units, too, a recommendation accepted by The Adjutant General.[42]

Administration of the training program of these college and city units presented certain difficulties, however, which had not been taken into account. The OCAC had publicly promised to permit, if

possible, members of a unit to complete training together. It was often unable to keep this promise, and when that occurred, the publicity boomeranged. The difficulty arose because the applicants' papers were forwarded individually to OCAC from corps area headquarters rather than as a group. Some papers were delayed; some arrived incomplete; sometimes upon review several candidates scheduled for a particular unit were found to be unqualified. It was impractical to postpone the assignment of an entire group because of a few deficient or delinquent applications. Consequently, it was often necessary to make up the deficiency by combining two or more potential units. Subsequently, in October 1941, it was decided to have all applications for training in one unit submitted simultaneously. Then, after the application and board proceedings had received final approval in the OCAC, the number found qualified for appointment would be sent to the same primary school and assigned to the same class regardless of the numbers originally accepted by the aviation cadet examining boards. Whether this simple change in procedure would have corrected the difficulties in the unit program was never tested, for the project had to be abandoned when war came. After Pearl Harbor the procurement and training of the greatest number of men in the shortest possible time was imperative. The cadet unit program was sacrificed in the interest of achieving this goal.[43]

Procurement rates generally managed to keep pace with training requirements in the period from 1938 to 1941 despite the inevitable clashes in policy which stemmed from the way the program was administered. The Chief of the Air Corps, the official most interested in these procurement policies, was forced to work through The Adjutant General on the one hand and corps area commanders on the other. Differences of opinion arose over methods of publicity and how it should be financed; over delegation of responsibility for and standardization of recruiting procedures; over who should give advice and assistance to volunteer civilian agencies; over the lack of facilities for examinations and the intervals at which board meetings were convened. The fault was sometimes with local commanding officers at Air Corps stations who failed to give active cooperation to the recruiting officers. Regular examining boards located at these stations were under the jurisdiction of corps area commanders and outside the control of station commanding officers. Thus some Air Corps stations showed no particular interest in the functioning of

the boards, and in one instance a combat-crew station (Mitchel Field) had so little time to devote to examining candidates that it considered the board a nuisance and sought to get rid of it.[44] Fortunately, such episodes were few.

Ground-Duty Personnel

Although the Army's air arm had been pilot-oriented from the beginning, and so continued during the early stages of the expansion period, it should be emphasized that the Air Corps had requirements reaching beyond those merely for pilots. To insure efficient performance of its functions the Air Corps had always required some nonflying personnel trained in such fields as aeronautical engineering, armament, communications, meteorology, and photography, but peacetime budgets and other considerations had seriously limited their number. As a consequence, and in order to provide an adequate number of officers familiar with the work of ground technicians, pilots were detailed to Air Corps mechanics and advanced technical schools where they took special courses to qualify themselves as engineering officers for all levels of command. Such training, however, was often incidental or superficial, intended primarily to enable pilot officers to supervise the work of enlisted technicians. Officers responsible for aircraft maintenance and the proper use and repair of aviation equipment frequently voiced their concern over this policy. Thus in 1930 Maj. H. H. Arnold, then executive officer for the Materiel Division at Dayton, bluntly declared there was something "fundamentally wrong with the educational system and assignment of personnel in the Air Corps." His concern at the moment was with depot engineer officers. Such personnel, he wrote, had to have a "fundamental engineering education," but officers so trained were then at a premium in the Air Corps and little or nothing was being done to develop them.[45] The situation described by Major Arnold had not been corrected, and the expansion program found the Air Corps with a serious shortage of technically trained ground-duty officers.

The origins of the problem went back to 1920 when Congress had authorized the Army to detail not more than twenty-five officers to take aeronautical engineering and allied courses in colleges and universities. This limitation had forced the Air Service to depend upon the Corps of Engineers, the Signal Corps, and other branches for skilled technicians to round out its personnel.[46] In 1926, when

the Air Corps Act was passed, the nonpilot permanent officer personnel in the Air Corps was limited to 10 per cent.[47] These limitations seem to have led many pilots to accept as normal the burden of providing engineering and other technical services, a belief that was most pronounced among those senior officers who held administrative posts in the OCAC at the time of the expansion. On two occasions in 1940 successive chiefs of the Plans Division ruled that "Air Corps officer pilots have always performed these duties in addition to their duties as members of combat crews and there appears to be no reason for departing from this practice at this time."[48]

By September 1940, however, it was becoming evident that this policy would have to be abandoned. At that time the Training and Operations Division, OCAC had decided to recommend to The Adjutant General that 100 men with degrees in engineering be enlisted as flying cadets and sent to New York University for a three-month preliminary course in engineering theory relating to aircraft maintenance. They would later be sent to the Air Corps Technical School for the regular enlisted mechanics course; after completing the course they would be commissioned for assignment as squadron engineering officers. The proposal was promptly approved, and the whole program placed under the direction of the commanding general of the Air Corps Technical School at Chanute Field.[49]

To work out details of this and other programs now agreed upon as necessary for the 54-group program, a conference, at which representatives from various universities were present, was held at Chanute Field in November 1940. The conference faced the problem of arranging for the technical training of 1,631 officers by the end of June 1942; of the total number, 561 were to be trained in engineering, 528 in communications, 392 in armament, and 150 in photography. Later, fifty meteorology officers were added to the procurement objective.[50] It was decided to enter the first classes in engineering at New York and Purdue Universities in January 1941; those in communications, at Scott Field in January and April 1941; and those in armament and photography, at Lowry Field in April and July 1941; and it was stressed that first priority for training in these four ground-duty categories was to be given to eliminated flying cadets. Until the fall of 1941 these training programs were restricted mainly to eliminees. Only in meteorology, a field in which few eliminated cadets had the educational background, was there a preponderance of candidates with no previous military experience.[51]

In general, it was felt that eliminees were better material for these programs than civilians. Not only had they been screened by two examining boards—briefly by a cadet examining board on entering service and more closely by an elimination board when washed out of flying training, to give the Air Corps an extensive file of their qualifications—but they had also received their basic military training and indoctrination, a phase of training that placed an additional hardship on the specialized school in the case of men recruited from civil life. One official summed up the advantages, when he said:

> We give priority on all appointments to specialized training to washed out pilot trainees. The doggone flying schools are still eliminating between 40% and 50% and it helps our pilot boys when they enter to know that if they can meet the educational qualifications for specialized training such training will be given them ahead of civilians. In addition to this we have the advantage of having them under close military supervision for a period of time and the judgment of the officer who has just had him under supervision in regard to his suitability for these types of specialized training.[52]

The use of eliminees, however, posed a problem which the planners had not taken into account. It had been the Air Corps' intent that, after finishing specialized training, these nonpilot cadets should receive reserve commissions and assignments to duty as squadron officers in their particular specialty. Since some of the specialized training programs lasted only ten weeks, it was possible for cadets who washed out from pilot training, which normally took nine months to complete, to get their commissions before their pilot classmates had completed training. This practice came under attack in the OCAC as being "unjust to the most important of the various training groups," and it was decided not to issue commissions to nonpilot cadets until they had completed six months' additional training with a tactical or other unit following graduation from specialized training classes. Not until the fall of 1941 was a way opened to permit earlier commissioning. The issue was then taken all the way up to the Chief of Staff, and later the Secretary of War directed that commissions should be granted to duly qualified and recommended aviation cadet graduates upon completion of courses of instruction prescribed by the Chief of the Air Corps.[53]

The job of procuring personnel for these ground-duty specialties was lodged with the flying cadet examining boards. Since most applicants in 1940 and 1941 were eliminees who had already appeared before a board, applications received by the boards were sent immediately to the Personnel Division, OCAC, the agency authorized

by The Adjutant General to monitor the procurement, appointment, and assignment of these trainees. Applicants had to meet the same general requirements as for pilot training: to present evidence of citizenship ten years before the date of application, be single and between the ages of twenty and twenty-six. Educational requirements, however, were another matter; in every instance they were higher than the requirements for flying cadet training. In engineering, the requirement was a degree in engineering, or senior standing in an engineering school; in communications, a college degree with credits in electricity or radio; in armament, where eliminees were to be the exclusive source, a college degree and a special recommendation for such training by the commanding officer of the previous training detachment; and in photography, a college degree with course work in either geology or chemistry. Those found qualified for the ground-duty program were then directed to take physical and character examinations administered by the flying cadet examining boards. The physical examination was the same as that required of reserve officers on extended active duty; the character examination was the type given to all officer candidates. Upon receipt of the results of these examination, the Personnel Division determined the names of those who should be placed on eligible lists maintained for each specialty.[54]

Because the first classes were small, the lists of pilot eliminees qualified for ground-duty training far exceeded the quotas, and as early as February 1941 training center commanders were urging that either the quotas be enlarged or that these eliminees be discharged. A few were discharged and sent home to await reappointment and assignment to specialized training, but in March 1941 the OCAC directed that those eliminees qualified for ground-duty training and waiting for classes be transferred to reception centers to await assignment to a definite class. The OCAC reasoned that it was preferable to "store" this personnel and run the risk of creating a temporary morale problem among those awaiting assignment than permit them to return to a civilian status which might give the public the impression that the Air Corps had more cadets than it could use.[55]

Two other sources supplied qualified applicants for the ground-duty programs, but the numbers obtained from them were fewer than might have been possible in view of the fact that the potential applicants were under military control. One group consisted of National Guard and reserve officers with technical qualifications and

experience who, after July 1941, could take aviation cadet training in grade. The War Department, however, lacked funds to finance their training and would permit only officers on active duty to apply for transfer to regular status in the Air Corps. The other group who might have qualified by reason of education and experience were the skilled enlisted technicians, but for them the outlook before the war was anything but favorable. Unit commanders were reluctant to lose their most competent enlisted men and in one way or another discouraged them from applying for aviation cadet training.[56]

It was not until October 1941 that the modest procurement goal of 1,631 ground-duty officers was increased. Then, in connection with the announcement of the 84-group, or 30,000-pilot, program, training center commanders were instructed to tell aviation cadets that current Air Corps policy was to train as many of them as possible as flying officers, but that those eliminated from pilot training should apply for training as bombardier, navigator, engineer, armament, communications, photography, or meteorology officers. Here was a clear indication that all restraints on the numbers of eliminees to be trained were to be removed and that a greater emphasis was to be placed on the ground-duty programs. An announcement in November confirmed the new policy, and it was stated that aviation cadets would be given preference forms to fill out and would have an opportunity to change preferences when eliminated from any training program. Finally, on 1 December 1941, an appeal was made by radio for more ground-duty recruits, a plea in which the point was made that for every plane in the air from six to twenty-two maintenance men were required on the ground.[57]

By December 1941 the number of students who had been enrolled in the aviation cadet ground-duty program since the expansion began totaled 2,586. The number entered in each category is shown in the following table:

	1940			*1941*			
	June	*Sept.*	*Dec.*	*Mar.*	*June*	*Sept.*	*Dec.*
Armament	...	...	...	84	127	333	366
Communications	...	...	...	122	124	123	123
Engineering maintenance	194	...	...	97	...	...	201
Photography	...	...	...	52	105	75	37
Weather	...	...	...	112	...	157	154
TOTAL	194	...	...	467	356	688	881

By the end of 1941 graduates totaled 1,402 and 46 cadets had been eliminated from training.[58]

With the outbreak of war, restrictions on numbers to be recruited for all programs were swept away with a rush. On 13 December 1941 the War Department announced it would seek a quota of 20,000 applicants a month between the ages of twenty and twenty-six for aviation cadet training. Before another year had passed there was a definite surplus of accepted candidates awaiting ground-duty training.

Reserve Officers

It would be difficult to overemphasize the important part played by reserve officers—both Air Corps and other—in the expansion of the air arm after 1939. By the end of 1940 there were some 2,300 Air Corps reserve officers on active duty. In addition, almost 1,500 officers holding reserve commissions in other arms and services had been detailed to the Air Corps for administrative duties. These figures may be compared with the 2,270 regular Air Corps officers then active.[59] The chief of the Personnel Division in January 1941 estimated that by the end of the fiscal year on 30 June no less than 82 per cent of the officers on duty would be reserves.[60] Not only did reserve officers supplement the flying personnel available for training and tactical assignments, but they made it increasingly possible to relieve experienced flyers of purely administrative duties.

Without this help it would have been impossible for the Air Corps to meet the extraordinary demands upon its limited resources, but the help was secured only at the cost of certain additional difficulties. The problem of the Air Corps reserve officer had long been a knotty one. Although the Air Corps Act of 1926 had stipulated a strength of 1,650 commissioned officers, the Air Corps, for budgetary reasons, had consistently operated at approximately 400 officers under strength. As a result, the vacancies for appointment in the regular establishment usually had been sufficient only to take care of applicants among the graduates of the Military Academy, who had preference. All but a few of the other graduates of the flying training center received reserve commissions. Congress in 1926 had authorized a maximum of 500 reserve officers to be called to active duty each year, 90 per cent of them to serve not less than six months nor more than one year, and the remaining 10 per cent to serve not less than one year nor more than two years.[61] With 200 or more annual

graduates from flying training, the opportunities for active duty after the initial tour remained decidedly limited.

The decision in 1939 to undertake a major expansion of the Air Corps eliminated this aspect of the problem for all practical purposes. Indeed, as early as 1936 pressure from the Air Reserve Association, combined with a need to meet the requirements of the newly established GHQ Air Force, had brought action by Congress authorizing the call to active duty of 1,350 reserve officers each year.[62] In April 1939, the statute which implemented the President's new program specified that a total of 3,000 reserve officers might be on extended active duty in any one year with the Air Corps. These officers were to be called, with their consent, for a year's service but with the understanding that the tour might be extended for a period not to exceed seven years.[63]

The difficulty now was that the opportunity to secure a regular commission remained limited at a time when the very plans for the Air Corps' expansion greatly increased the opportunities open to trained flyers in civilian life. An act of April 1938, while allotting 2,092 regular commissions to the Air Corps, had stipulated that 10 per cent of the number trained each year should be eligible for commission in the regular establishment.[64] One year later Congress authorized the immediate appointment in the Regular Army of 300 second lieutenants from the reserves, who had to be graduates of the training center and under 30 years of age. Later, The Adjutant General announced that 100 additional commissions would be granted in the fall. Thereafter, the plan was to commission some 128 officers annually, with half of these vacancies held for reserve officers.[65] This policy opened the way for some of the younger pilots, but the prospect for older men remained poor.[66] Moreover, many of the younger men had to consider that seven years of extended duty would carry them past the thirtieth birthday, which would make them ineligible for a regular commission.[67] Consequently, there were some who refused to accept the call to active duty and many of those on duty requested relief in order to accept the better paying jobs offered by flying schools, civil airlines, aircraft manufacturers, or other organizations in which flying experience stood at a premium.

As late as August 1940 it was still established policy to grant all requests for relief upon completion of the initial tour, a policy supported in part by the knowledge that most of the officers relieved

would continue in a civilian activity of vital importance to the attainment of Air Corps objectives.[68] But the Air Corps' own need for trained officers was becoming such that vigorous opposition to the practice had developed in some staff offices.[69] The problem was eased by legislation of 27 August 1940 which authorized the President to order into active service all reservists, with or without their consent. The length of service was to be for a period of twelve consecutive months. The Judge Advocate General ruled that under the terms of this legislation reservists who were called to duty with their consent would be subject, as were those called under the act of April 1939, to having their tours extended each year until they had served seven years. Only reserve officers who had been ordered to active duty without their consent would be eligible to apply for relief at the expiration of a twelve-month tour.[70] However, the President's proclamation of an unlimited emergency on 27 May 1941 made this ruling inoperative before any reservist could benefit from it.

Efforts to secure reservists from other arms and services began in the spring of 1940. By November an original allotment of 1,497 had been exhausted, and additional assignments were being requested.[71] In September 1941 over 3,500 officers from other arms and services were on duty with the AAF within the United States; at the time of Pearl Harbor the number was close to 4,000. Figures for those then serving overseas are not available.[72] By July 1941 the AAF had called to active duty all of its own reserves who voluntarily accepted extended active duty, and was calling the remainder without consent.[73] It could be anticipated that new graduates of the expanding training program would soon add greatly to the number of flying officers on active duty. But this was the period when no Air Corps program could be met before some higher goal was set. On 26 July 1941 Arnold urged upon the Chief of the Air Corps the continuing necessity to relieve all flying personnel "at the earliest possible date from administrative duties not requiring the background of flying experience."[74]

With only a small force of regular officers and with its own reserve strength limited almost entirely to the earlier graduates of Randolph, the AAF during the next two years would resort to virtually every device to fill its growing requirement for officers. At the end of 1943 its regular officers represented only 1.3 per cent of the total number of officers on duty, as against 2.6 per cent for the Army

Service Forces and 3.5 per cent for the Army Ground Forces.[75] The difference is explained in part by a proportionately higher requirement in the AAF of officers with reference to the total number of enlisted men; according to the 1944 troop basis, for every 1,000 men the AAF needed 156 officers, ASF 97, and AGF 54.[76] Since the relative requirement for officers was higher in the combat units than elsewhere, the AAF met its most critical need for officers through its expanding flying training program. But each new tactical unit multiplied the administrative posts that had to be filled and increased the requirement for nonflying specialists. Of the 388,295 officers who in May 1945 represented the AAF's peak strength in this category, over 48,000* had been commissioned in some arm or service other than the Air Corps.[77] The 335,909 Air Corps officers, moreover, included many specialists who had been commissioned direct from civilian life, and who were the products of special officer training and candidate schools established soon after Pearl Harbor.†

The direct contribution made by the National Guard to AAF strength was a small one. At the beginning of the expansion there had been a total of 19 National Guard observation squadrons. In 1939 Congress showed some inclination to underwrite a program for the establishment and maintenance of approximately 100 National Guard aviation units. But the Air Corps successfully opposed the proposal as one that would seriously complicate plans for the projected expansion of its own facilities.[78] The addition of ten new observation units was accepted as sufficient. The National Guard units were inducted into federal service at intervals following the executive order of 16 September 1940 which called up the Guard. As they were received, they were attached to various armies and corps as reconnaissance squadrons.[79] A postwar evaluation of the contribution made to the AAF by the 29 National Guard units credits them with supplying 468 rated pilots.[80]

* In November 1943 the total had been 56,188.

† See below, pp. 680–84.

CHAPTER 14

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THE FOUNDATIONS OF A WAR TRAINING PROGRAM

WHEN the Air Corps began to lay its plans for expansion in the fall of 1938, one of its major tasks was the provision of facilities for the additional thousands of men to be trained as flying cadets and for the even larger numbers to be taught to service and maintain aircraft and aircraft equipment. Training officers realized that existing facilities would have to be augmented, yet they expressed concern lest in the process of expanding, the quality of training suffer. Consequently, planners in the Office of the Chief of the Air Corps maintained that if Randolph Field and its counterparts were inadequate for the job, the Air Corps should build more Randolph Fields. This emphasis on a continuance of high standards was understandable, but it took no account of the time lag that the proposed construction would entail, a factor that could not be overlooked.

Time was indeed all-important, and for this reason General Arnold decided to overrule the experts on his staff. Flight training, as it had been developed during the prewar years, was divided into several phases: in the first of these, *primary*, the student learned to fly a light and stable aircraft of low horsepower; in *basic* training he made the advance to a heavier plane with more complex controls; in *advanced* flight training he learned to fly a machine whose characteristics approximated those of combat aircraft; and in *transition* the student learned to fly the combat plane itself—usually after he had won his wings. It was General Arnold's hope in 1938 that by turning over the responsibility for primary training to other agencies, he could free the Air Corps to concentrate its full resources on later phases of training, and thus in effect expand the capacity

of its own training establishment. Accordingly, in October of that year he invited to Washington representatives of three of the nation's best civilian flying schools—Oliver L. Parks, of the Parks Air College, Inc., East St. Louis, Illinois; C. C. Moseley, of the Curtiss-Wright Technical Institute, Glendale, California; and Theopholis Lee, of the Boeing School of Aeronautics, Oakland, California. Out of this conference came the first tentative plans for what was to become the standard practice for primary flight training during the next six years. As General Arnold later related: "I made them a proposal. I told them I didn't have any money but was sure I could get the support of Congress in the next appropriations bill. Would each of them be willing to go out and set up at his private school the facilities to house, feed, and train flying cadets for the Army Air Corps?"[1] Acceptance of the proposal would entail each school operator's taking the considerable risk of investing several hundred thousand dollars in a venture backed only by Arnold's word. After a long discussion, punctuated by General Arnold's reference to the challenge that such a venture offered, the men agreed that they not only could but would do the job.[2]

Arnold then appointed a board of officers to survey civilian flying schools for the purpose of ascertaining how soon the schools could begin operations and to check on their potential capacities. The board brought in a favorable report on 25 November 1938 and proposed that under such an arrangement 4,500 pilots be trained within two years. The OCAC approved the report in principle, and its training staff took steps to define the responsibilities of the Air Corps Training Center and the corps areas in the event that authorization was granted to proceed with the plan.[3] A parallel development was under way with respect to technical training. On 10 November 1938 Col. Gerald Brant, commandant of the Air Corps Technical School at Chanute Field, initiated an inquiry as to the availability of civilian mechanics schools for Air Corps expansion, and by late December ten such schools in the western United States had been inspected. In the spring of 1939 four more excellent civilian schools were found in the East.[4]

Before entering into contracts with civilian schools, however, it was necessary for the Air Corps to obtain War Department and Congressional approval for the program, since there were rigid statutory limitations on the number of Army personnel who could be trained

in nonmilitary schools. To sanction the proposed steps, drafts of legislation were submitted to the Chief of Staff on 14 December 1938 which embodied authority to: 1) train Air Corps personnel in civilian schools; 2) train flying instructors of civilian flying schools at Air Corps schools for standardization of instruction; and 3) furnish training planes for training of Air Corps personnel to civilian schools.[5] In testimony before committees of the Congress it was explained that these steps would materially reduce the time required for the expansion of the Air Corps and that tuition costs and other expenses would be largely offset by savings in additional airfields, materiel, personnel, and equipment.[6] The civilian school operators also brought their influence to bear upon members of Congress, emphasizing the savings both in time and cost that would be effected by adoption of the proposed expedient.[7] On 3 April 1939 Public Law No. 18 authorized the Secretary of War to detail Army personnel as students to any technical, professional, or other educational institution, if Army facilities were insufficient; at the same time the loan of government airplanes to civilian schools giving training to military personnel was also authorized.

The Civilian Schools

The Air Corps lost no time in putting its plans into operation. In May 1939 nine civilian schools* received notice of their selection to give primary flight training starting in July.[8] As early as 27 May 1940 General Marshall in a talk before the National Aviation Forum at Washington, D.C., emphasized the success which had been achieved by this Air Corps "experiment in making direct use of civil aviation schools for the training of Army pilots." He added, with obvious reference to the new 7,000-pilot training program and the impending announcement of the 12,000-pilot training program, that the Army was "about to enlarge tremendously on this logical procedure, which both stimulates civil aviation and facilitates the development of the Army Air Corps."[9]

Each of the original nine schools was now directed to establish a branch. This assignment was more difficult than the original job,

* Spartan School of Aeronautics, Tulsa, Okla.; Santa Maria School of Flying, Santa Maria, Calif.; Dallas Aviation School and Air College, Dallas, Tex.; Ryan School of Aeronautics, San Diego, Calif.; Alabama Institute of Aeronautics, Tuscaloosa, Ala.; Grand Central Flying School, Glendale, Calif.; Parks Air College, East St. Louis, Ill.; Lincoln Airplane and Flying School, Lincoln, Neb.; and Chicago School of Aeronautics, Glenview, Ill.

for it was necessary to prepare farm and desert land for flying activities and construct buildings and other facilities for planes and men. But by August 1940 nine more schools were in operation. By March of 1941, when the 30,000-pilot training program was announced, eleven schools had been added, and in October 1941 fifteen more schools began primary training. Included in the list was a small school established at Tuskegee, Alabama, exclusively for the training of Negro pilots. By Pearl Harbor the number of civilian primary schools totaled forty-one. Three of the original nine schools had been closed: those at Glenview, Illinois, and Lincoln, Nebraska, because of a climate which interfered with training; and the school at Glendale, California, because of congested air traffic.*[10]

In the contracts each primary school operator agreed to furnish equipment, flying fields, supplies and facilities for training, exclusive of aircraft and such airplane parts, equipment, and accessories as would be provided by the government; he was to furnish suitable facilities, with adequate heat, light, and ventilation in all buildings, plus an adequate sanitary system, and to make transportation available for students whose place of instruction was more than one mile from lodgings. The contractor was required to carry full public liability and property-damage insurance. For its part, the government agreed to lend training aircraft, without obligation to repair or replace, but with an option to make major repairs and overhaul. By December 1941 over 3,000 planes were in use. The government also supplied textbooks, helmets, parachutes, goggles, and flying and mechanics clothing. The Air Corps was authorized to maintain constant supervision and inspection and had the right to pass judgment on the serviceability of planes and the adequacy of all facilities furnished by contractors. Air Corps representatives were to observe training methods and determine the proficiency of the students.[11]

For each graduate of a civilian primary flying school, the government originally agreed to pay the contractor $1,170. For students eliminated from the program, the contractor was to receive $18.00

* The peak of primary flight training was reached in May 1943, when there were fifty-six schools in operation. The peak graduation figure was attained in November 1943, when 11,411 aviation cadets were sent on to basic flying training schools. Retrenchment set in immediately thereafter, and only ten schools survived the year 1944. By August 1945, only Tuskegee, for training Negro students, and Orangeburg, South Carolina, a school which trained French students, remained in operation. The closing-out procedures were based on location, weather, performance records, as well as the financial status of the contractor. (See History, AAF Training Command, 1 Jan. 1939–VJ Day, III, 502–3.)

for each hour of flying training given the eliminee. Government officials were to have the right to inspect all records and to terminate the contract on thirty days' notice. In July 1940 contracts were modified slightly by lowering the standard compensation for each graduate to $1,050 and to $17.50 per flying hour for eliminees. After Pearl Harbor it was necessary for the government to increase the pay of the contractors in order to allow for more extensive guard service. Later, too, the government agreed to furnish gasoline, oil, and lubricants. When the program ended, the government was paying $10.00 per hour of instruction at some schools, and somewhat more at others. The government also decided, shortly after Pearl Harbor, to have the Defense Plant Corporation purchase all land, buildings, hangars, and unmovable equipment. The contractor retained ownership of what was left and paid the Defense Plant Corporation a rent of $3.70 for each hour of instruction and $1.15 daily for each cadet's quarters.[12]

To help prepare the civilian schools for their job, the Air Corps Training Center set up a refresher course for civilian flying instructors at Randolph Field which was given during June and July 1939.[13] By late 1940, when the original nine schools had established branch schools, the three training center headquarters* were sending out supervisors and assistants, with planes, to train the instructors and maintenance men who, in turn, would train others as the need arose. After war came, regional instructor schools gave training to civilian instructors for primary schools. Later, in 1943 and 1944, this training was given at the central instructors school established at Randolph Field.[14]

Starting 1 July 1939 classes were entered at primary schools every six weeks, the training program lasting twelve weeks. The length of the course was cut to ten weeks in May 1940, with classes entering every five weeks, and to nine weeks in March 1942. In all programs, however, the flying time was sixty hours, but drastic cuts were made in the ground-school phase of training. During 1939 a total of 225 hours had been devoted to ground-school instruction. This was cut to 140 hours in mid-1940 and to 84 hours early in 1942, as more and more of the ground-school training was transferred to the preflight schools.[15]

The size of each entering primary flying training class was 396 until 18 May 1940, when the number was jumped to 466. This was

* See below, p. 465.

but a prelude to much greater increases, as the War Department announced that starting in June entering classes would number 605 flying cadets; in August, 900; in September, 1,100; in October, 1,234; and in November 1940 and thereafter, 1,292. Such progressive increases in the size of classes would make it necessary to procure more instructors; flying instructors, which then totaled 135, were to be increased to 430, and ground-school instructors from 20 to approximately 100.[16]

Perhaps the most important single factor in determining the efficiency of a civilian flying school was the quality of its flying instructors. When the program began, the experience level was high, the majority of the instructors being men with over 1,000 flying hours. As training expanded, however, the procurement of competent flying instructors became a major problem. Since pilots were everywhere in demand, the schools were also constantly being "raided" by the AAF, the Ferrying Command, the Navy, the commercial airlines, the aircraft manufacturers, and by selective service boards. To protect the primary school staffs from these inroads and to aid in overcoming a continuing shortage of properly qualified flying instructors, the War Department requested the airlines and aircraft manufacturers not to take men from school staffs without allowing adequate time for training replacements, a request to which the companies agreed. In May 1941 state selective service directors were instructed to give serious consideration to deferment of men required for operation of primary civilian flying schools, and both flying instructors and mechanics were classified as being engaged in essential occupations. But local draft boards did not always follow official recommendations and continued to call up men employed on civilian school staffs. Without doubt, however, the most serious competitor was a sister service; Navy recruiting officers held out very attractive offers to civilian flying personnel, and despite repeated promises not to proselyte, the Navy continued to do so as long as it needed pilots.[17]

The best protection for civilians employed by the contract schools was the Air Corps Enlisted Reserve, but this did not appeal to the instructors. The public was inclined to stigmatize reservists as draft dodgers; moreover, these men considered that they were performing a service that warranted a commissioned status. For these reasons few instructors had joined the Air Corps Enlisted Reserve before enlistment was suspended at the end of 1942. When enlistment was reopened in mid-1943, more, but by no means all, of the instructors

and mechanics enrolled as reservists. The use of civilians for flying and ground-school instruction and for maintenance work at civil schools had one distinct advantage, however, since it brought many men into the program whose age and/or physical disability kept them out of the Army. It should also be noted that some schools solved the mechanics problem by employing women and by introducing labor-saving devices and production-line maintenance.[18]

Other problems faced by the contractors included some that increased their financial risk. A most perplexing problem for the contractors, for example, was the constant fluctuation in school quotas. Schools discovered that they could never be sure how many students they would receive. If too many, then the contractor had to make haste to get more instructors; if too few, then the contractor lost money. Some contractors sought to protect their investment by bickering over every point and were niggardly in supplying recreational facilities, which assumed a much greater importance in maintaining morale after the first year when additional schools were established in areas remote from urban developments. Some contractors recognized this obligation by operating busses without profit for the convenience of cadets in getting to town and to housing projects.[19]

The civilian school contractors did yeoman service when the fledgling AAF was most in need of help. When the program began, the Air Corps simply did not have the means to expand as fast as the situation demanded. The importance of the venture was put most succinctly by General Arnold in 1944, when he said: "We could not possibly have trained so many airmen so quickly without these schools."[20] Not until the pilot-training program had begun to taper off at the end of 1943 was it politic or practical for the Training Command to announce the results of studies it had made on the relative merits and costs of civilian versus military schools. Such studies showed that flying training would cost approximately $1.76 per flying hour more in military than in contract schools.* But

* Each school had, in addition to its civilian personnel, a small military detachment to supervise the military aspects of aviation cadet training and to act in a liaison capacity with training center and other AAF stations. A typical primary school (Santa Maria, California) early in 1944, with about 300 students in each class, had a military complement of 56, consisting of 1 major, 5 captains, 8 first lieutenants, 6 second lieutenants, 14 sergeants, 14 corporals, 7 privates first class, and 1 private. Its civilian personnel numbered 278 and was composed of 128 flying instructors, 7 ground-school instructors, 1 parachute rigger, 128 mechanics, and 14 civilian guards. (History, AAF Training Command, III, 508.)

Training Command officials believed that military schools provided better pilot training, better care for the health and morale of the trainee, and incidental training for larger numbers of military personnel.[21] The fact remains, however, that the civilian schools were not discontinued until the program for training pilots was safely "over the hump," at which time the Training Command had surplus air bases that could handle the decreasing flow of pilot trainees.

In May 1939 the Air Corps had also turned to civilian schools for the training of mechanics. At that time War Department authorization was given for contracts with seven schools,* whose training programs were to begin on 7 August 1939 under the supervision of the commandant of the Air Corps Technical School at Chanute Field.[22] By the end of the summer OCAC was circularizing additional institutions with a view to expanding the program, but found that many were reluctant to agree because civilian patronage of the schools alone exceeded their capacity. It was a different story, however, by March 1940. Schools were now anxious to obtain Air Corps contracts, and in October 1940 seven more civilian mechanics schools received contracts. In January 1941 the fifteenth school was added. There were no further additions before Pearl Harbor.[23]

The contracts for the training of these enlisted technicians specified the scope of the program to be offered, length of the course, payments, and the right of government supervision and inspection. The contractor agreed to furnish 960 academic hours of instruction in accordance with a syllabus issued on 21 April 1939. The courses were to run from twenty-four to twenty-eight weeks, the number in any one class was not to exceed forty-four, and there were to be no more than seven classes under instruction at any one time, new classes to be entered every two weeks. Instructors were to be at least journeymen in their trades and to have Air Corps approval. The contractor was to furnish textbooks, tools, facilities, and equipment, including airplanes and airplane engines. Lodging and board were to be provided at a cost not to exceed $11.00 per week, and the contractor was to furnish transportation between lodging and school when the distance was greater than a mile. The government was to furnish

* Contracts were signed with the following institutions: Aeronautical University, Chicago, Ill.; Casey Jones School of Aeronautics, Newark, N.J.; Curtiss-Wright Technical Institute of Aeronautics, Glendale, Calif.; New England Aircraft School, East Boston, Mass.; Parks Air College, East St. Louis, Ill.; Roosevelt Aviation School at Roosevelt Field, Garden City, N.Y.; Spartan School of Aeronautics, Tulsa, Okla.

mechanics clothing, and the loan of government property was permitted for instructional purposes. Each contractor was to receive an estimated sum not to exceed $101,836.80, which was based on a payment of $374.40 for each student graduated; the payment for eliminees was to be figured at 39 cents for each academic hour of instruction received.[24] In the spring of 1940, when the OCAC Training and Operations Division prepared, in connection with the 7,000-pilot training program, the plans for training an additional 4,000 enlisted mechanics at civilian schools, a complete cost breakdown indicated that the total expense of training 4,000 mechanics would amount to $4,455,480,* which would make the cost of training each mechanic come to $1,113.87.[25]

Air Corps inspections of the caliber of training given at civilian mechanics schools indicated that at this time no civilian school had attained the standards of the Air Corps Technical School, although Colonel Brant, the school's commandant, acknowledged that steady progress had been made toward such a goal. Discrepancies were caused mainly by lack of equipment and by unfamiliarity with the rigid system of Air Corps maintenance. In their efforts to match the training of the Air Corps institutions, the civilian schools sought and generally got instructors of high quality. Curtiss-Wright recalled outstanding graduates from industries; at Casey Jones in 1940 instructors were all technical or trade school graduates with years of experience at that school; at Boeing the original instructors were either Air Corps Technical School graduates or men who had worked in aircraft factories; at the New England Aircraft School all instructors were ex-Air Corps men with from one to six years' experience.

* Specific items were as follows:

Tuition—960 hours at $.40 per hour ($384.00 each)	$ 1,536,000
Commutation of rations—28 weeks at $1.20 per day ($235.20 each)	940,800
Commutation of quarters—28 weeks at $.75 per day ($147.00 each)	588,000
Travel from replacement center to and from school —average distance 600 miles at $.03 per mile ($18.00 each)	72,000
Equipment—purchase of technical equipment	240,000
TOTAL	$ 3,376,800
291 civilian instructors	629,400
312 clerk-stenographers	449,280
GRAND TOTAL	$ 4,455,480

Throughout the pre-Pearl Harbor period all men sent to the civilian mechanics schools as students were members of the Regular Army. In the early classes many trainees were men with extensive line experience; they were interested in their work and learned quickly. Gradually they were succeeded by men of inferior quality, some of whom had been haphazardly chosen and others who had no interest in the course.[26] The wide use of aptitude tests during the war period resolved most of this trouble.

A variety of housing and messing arrangements was established by these institutions, improvisations made necessary by the urgency of the program and the kind of facilities locally available. Six schools constructed barracks; others used hotels, YMCA's, apartments, auditoriums, and hangars. The Rising Sun School in Philadelphia used approved rooming houses within a one-mile radius of the school. Dispersion of students in 250 homes, however, made discipline difficult, and it was necessary to make frequent spot and bed checks at night. Rising Sun students ate their meals at these private homes; at other schools mess halls were established, or arrangements were made to mess the students at cafeterias, restaurants, hotels, and YMCA's.[27]

By December 1941 the 15 civilian schools had trained 6,968 airplane mechanics, 356 aircraft sheet-metal workers, and 38 aircraft welders. During this period the elimination rate had been approximately 7 per cent. Chanute Field, by comparison, had turned out 17,945 airplane mechanics from 1 July 1939 to 31 December 1941. Enrollment figures for December 1941 show that there were 15,800 students in airplane mechanics courses at Chanute, Keesler, and Sheppard Fields, and 4,008 students at the civilian mechanics schools. Having demonstrated that a satisfactory training program could be accomplished at civilian schools, the venture was greatly expanded after war came.[28]

Even before Pearl Harbor the demands made on the Air Corps' technical schools for an expansion of their output of skilled aviation technicians prompted OCAC to make arrangements to train other categories of specialists at civilian institutions. The Adjutant General had been asked in June 1940 to take steps to have pending legislation amended so as to suspend limitations on the number of enlisted men "who may be detailed as students at technical, professional and other educational institutions or as students, observers or investigators at industrial plants, hospitals or other civil institutions."[29] At the time

this request was made, OCAC stated that the training of approximately 3,000 administrative clerks would have to be done at civilian schools because Lowry and Chanute Fields were to be operated at full capacity to train the more critically needed armorers and bombsight specialists.

The OCAC also found it practical to enter into contracts with universities and other institutions whose curricula offered training in certain specialties for which the Air Corps had urgent need. Thus, for example, contracts were made with Purdue and New York Universities and with the Academy of Aeronautics at La Guardia Field, New York, for the training of aviation maintenance engineers; and with New York University, Massachusetts Institute of Technology, California Institute of Technology, University of Chicago, and University of California at Los Angeles, for the training of selected groups of students in meteorology.[30] As the program was enlarged in the fall of 1941, other contracts were made with commercial airline schools and with factory training schools. Further expansion came after war had been declared, and by October 1942 technical training for the AAF was being offered at thirty-four civilian mechanics schools, five universities, five commercial airline contract schools, and approximately fifty factory training schools.* Except for the mechanics courses, which absorbed almost half of the students entered into training under the 300,000-technician program adopted in January 1942, most of the courses offered by these civilian institutions were attended by relatively few students who in the aggregate constituted but 15 per cent of the total student group receiving technical training. Included in these minor programs were courses for machinists, metal workers, welders, Link trainer instructors, parachute riggers, teletype operators, weather observers, weather forecasters, and specialists in power plants, electricity, instruments, propellers, power turrets, and bombsight and gunsight maintenance.[31]

* The peak of the technical training program at civil schools was reached in the spring of 1943. The decision to close out many of the schools was made at this time because government-owned facilities would soon accommodate the decreasing flow of students. Contracts with all civilian mechanics schools were canceled in May and June; all civilian depot overhaul schools were eliminated; and all civilian clerical school contracts were canceled except for schools at Greeley and Fort Collins, Colorado. Factory schools were continued on a curtailed basis, while the program for training weather observers and forecasters was retained and expanded.

Expansion of Air Corps Schools

The assumption by civilian contractors of responsibility for primary flying training left the Air Corps' regular training establishment free to concentrate its efforts on more advanced training. Up to 1940 the Air Corps Training Center had experienced no serious difficulty in keeping up with the demands of an expanded program. Randolph Field had ample facilities to give basic flying training to the graduates of all nine of the civil schools. Nearby Kelly Field and Brooks Field were deemed adequate, with some improvement in facilities, to assume the burden of advanced training.[32] But the picture changed abruptly in the spring of 1940 as Hitler's armies overran western Europe. The Training and Operations Division, OCAC rushed to completion studies already under way for an increase in training objectives, and the new goal was promptly set at a rate of 7,000 pilots per year. In addition, it was concluded that bombardiers and navigators would have to be trained at a rate of 3,600 per year. And it was clear enough that these objectives could be met only through a major expansion of the Air Corps' own training establishment.[33]

In May 1940 the Chief of the Air Corps was ready to propose a reorganization of flying training and the establishment of two additional training centers. Under the new arrangement, the nation was to be divided into three geographical zones. All flying schools located east of the 92d meridian were to be placed under the jurisdiction of a Southeast Air Corps Training Center with headquarters at Maxwell Field; those situated between the 92d and the 108th meridians were to be administered by a Gulf Coast Air Corps Training Center with headquarters at Randolph Field; and those west of the 108th meridian were to be under the jurisdiction of a West Coast Air Corps Training Center located at Moffett Field, California. The proposal received War Department approval late in June, and the new training centers were activated on 8 July 1940, each of them to operate under the immediate jurisdiction of OCAC. The order establishing the centers stipulated that the headquarters personnel would consist of a commanding officer and not more than five additional officers.[34] In view of the vast amount of supervisory and administrative work connected with the establishment of new schools and training programs, the procurement of instructional supplies and equipment, the selection and training of instructors, and the hiring of civilian personnel, such

a small staff proved to be altogether inadequate and each of these headquarters eventually grew many fold.*

The most urgent of immediate tasks confronting the new centers was to assist OCAC in the selection of sites for new schools, and since training objectives continued to be pushed ever higher, there was to be no early relief from the responsibilities thus imposed.[35] Each center appointed boards, normally composed of four officers each, to inspect sites, report their findings, and make recommendations to the War Department for final decision. Since it was important that stations be located where flying training could be conducted during the greatest number of days in the year, weather was a prime consideration in site selection. The boards adopted a general policy of confining their choices to sites south of the 37th parallel when experience demonstrated that weather conditions there were most conducive to uninterrupted flying. Other factors that had to be considered included provision for housing of station personnel, both military and civilian, in nearby communities; transportation facilities as these affected supply; the availability of water; and the possibility of further expansion. These factors became the more limiting as successive expansions narrowed the number of areas that had not already been exploited. The training center that found itself most seriously restricted both by these considerations and by competition from other military agencies who were also expanding their activities was the West Coast Training Center. Consequently, its eastern boundary was shifted from the 108th to the 103d meridian in 1941, in order to permit the establishment of training fields in the mesa country of eastern New Mexico and western Texas. Headquarters of WCTC was shifted to Santa Ana, California, early in 1942.

The first plans for increasing flying training depended chiefly upon the adaptation and expansion of older installations. Two bases formerly used by other units of the air arm—Maxwell Field and Moffett Field—were assigned to the Air Corps for use as additional basic flying schools. Three new advanced flying schools were projected—at Montgomery, Alabama; San Angelo, Texas; and Stockton, California. Eglin Field at Valparaiso, Florida, and what was to become Craig Field at Selma, Alabama, were designated as sites for specialized pur-

* This was particularly true after the establishment of the Flying Training Command early in 1942. At that time the training centers were removed from the immediate jurisdiction of the OCAC and made subordinate to the new command.

suit schools and were to be readied to relieve the GHQ Air Force of responsibility for this phase of training by February 1941. Barksdale Field at Shreveport, Louisiana, was concurrently designated as a school for training one class of pursuit instructors during the autumn of 1940, after which it was to become a specialized school for bombardment pilots, bombardiers, and navigators. Ellington Field, an older and previously abandoned base near Houston, Texas, was to be rebuilt for use as a second specialized multiengine bombardment training school. Funds amounting to $6,092,650 were provided to finance construction of new facilities at these stations. Then, just as the public was being informed of the steps to be taken to put the new expansion into effect, the fall of France on 22 June 1940 prompted Congress virtually to invite the Air Corps to expand its program even more.[36] During July the Secretary of War authorized a raise in the pilot-training rate to 12,000 per year, the planning was finished in August, and the funds were appropriated in September.[37] Included in the facilities for this program were eight new flying training schools, two new gunnery stations, and five cadet reception centers.* Most of the new schools were ready for use in June 1941, and the cadet reception centers were occupied in the fall and winter of 1941–42. Even before these facilities had become available, however, the Air Corps had plans drafted for a still larger goal, a training rate of 30,000 pilots per year. Known as the Army's Second Aviation Objective, this expansion was directed by the Chief of Staff on 14 February 1941, and funds were voted on 5 April to provide twenty additional new flying training schools, one more new gunnery station, and one additional cadet reception center.† Very few of these installations were ready for use by 7 December 1941, but they were all in operation by June of 1942.

As time progressed, the lagging in the training of bombardiers, navigators, and gunners gave training staffs their chief cause for concern.‡ In the old Air Corps the training of bombardiers had been left to the tactical units of the GHQ Air Force.[38] Because of the priority given to pilot training by the combat units, however, instruction in bombardment techniques when given was performed "coincidently";

* For locations of these additional facilities, see above, pp. 137*n*, 138.

† For locations of these new facilities, see above, p. 139*n*.

‡ Training in flexible gunnery was especially retarded; instruction at specialized schools did not begin until 9 December 1941.

there was neither standardized instruction nor a complete manual to follow.* Curiously enough, in view of the Air Corps' emphasis on precision bombardment, few records of what was actually done were extant when Headquarters, AAF sought them late in 1942.

OCAC had been authorized in July 1940 to inaugurate a training program for bombardiers, not as a substitute for the work done in the combat units but as a supplement to it. Lowry Field was selected as the site for a school which, between 16 July 1940 and 15 March 1941, trained, in three classes, 122 bombardier instructors. Next, a "test class" of cadet bombardier students was trained from which thirty-four were graduated. Because the weather was not conducive to training of bombardiers in the Denver area, it was then decided to transfer the school to Barksdale Field, where training began on 3 May 1941. By the end of November 144 men had been graduated in four classes, but the climate here was no better than it had been at Lowry. It was therefore decided to transfer bombardier training as quickly as possible to Texas, where it was hoped that weather conditions would be better for the flying phases of bombardier instruction. The first Texas site selected was Ellington Field, where training began 4 October 1941. Once again, however, the weather proved to be unsuitable, and only one class of twenty-six bombardiers was trained at Ellington Field. Thus, during a period of approximately eighteen months and after experimenting with three schools, the number of graduates consisted of but 122 bombardier instructors and 204 cadet bombardiers. When the United States entered the war, "it could hardly be said that the program for bombardier training was even well begun, though some expensive lessons had been learned."[39]

The first step in the development of a wartime bombardier-training

* Perhaps the most interesting example of bombardier training by tactical units was that conducted by a station outside the continental United States. During November and December 1939 Hickam Field, in Hawaii, gave individual bombardier training to a class of enlisted men, an experiment that led to the conclusion that carefully selected men with a high school education could be trained in the art of bombing. This idea was ultimately adopted, not only for bombardiers but for pilots and navigators as well, when the aviation cadet qualifying examination replaced the two-year college requirement in January 1942. (See AHS-2, Initial Selection of Candidates for Pilot, Bombardier, and Navigator Training.) This should not be confused with the question of the commissioning of bombardiers. Prior to 1941 some consideration was given to the idea of training bombardiers for duty as enlisted members of the aircrew. (See, for example, requirements for the 12,000-pilot training program, which included training of 1,269 officer bombardiers and 1,868 *enlisted* bombardiers, contained in R&R, B. K. Yount, Chief, Plans Division to Training and Operations Division, 17 October 1940.)

program was the transfer of Albuquerque Air Base from the Air Force Combat Command to the West Coast Training Center in December 1941 for use as an advanced bombardier school. Construction was also rushed on ten new schools, the first of which was opened at Midland, Texas, in February 1942 as a replacement for Ellington Field. One year later the last of the new schools began training. All were located in the southwestern states where weather was excellent for practice bombing runs.* By February 1943 a total of 7,378 bombardiers had been graduated, and the bombardier schools were turning out graduates as fast as they could be absorbed by the operational training units.[40]

The development of a program to train a separate member of the aircrew as a navigation specialist followed a pattern very similar to that of bombardier training. Before 1933 there had been no necessity to offer navigation training beyond that included in the pilot-training courses. In the next six years, however, combat units performed a varying amount of specialized navigation training, and when the expansion program was inaugurated in 1939, plans were formulated to accentuate this type of training. By now, the prospect of long-range bombing had prompted a decision to include a competent officer navigator in the crew of each medium and heavy bombardment squadron and the attached reconnaissance squadron. At the time the decision was made, there were 166 qualified navigators on hand in the GHQ Air Force. The number needed to implement the program was 506. Not until the United States was well into the war period did the supply of trained navigators catch up with the demand, a demand that shot upward with each increase in the pilot-training rate upon which the directives for such specialized training programs as this were based.[41]

One thing that held up the production of navigators in the prewar years was that practically all individual training of navigation specialists was carried on in the GHQ Air Force and its successor, the Air Force Combat Command. Training programs conducted by these units had to be fitted into a highly crowded work load, for, in addi-

* The sites of the other bombardier schools, and the month when training was begun, are as follows: Victorville, Calif., March 1942; Roswell, N.M., and Higley, Ariz., June 1942; Big Spring, Tex., San Angelo, Tex., and Hobbs, N.M., September 1942; Carlsbad, N.M., October 1942; Deming, N.M., December 1942; and Childress, Tex., February 1943. The school at Carlsbad became a central bombardier instructor school in January 1943.

tion to carrying on their regular operations, they were all engaged in one or more types of other specialized training. Moreover, until the training centers could set up their own pilot schools, the GHQ Air Force units were given the responsibility for the transition of advanced pilot trainees to combat planes. The navigation training programs were therefore less detailed and less academic than those ultimately conducted by Air Corps schools. Of necessity, this training was designed to effect the earliest possible attainment of combat proficiency.[42]

Since the Chief of the Air Corps had made no provision for setting up specialized navigation schools when the 7,000-pilot training program was launched, it was decided to use the facilities of an existing civilian school, and a contract was made with Pan American Airways System (PAA) to train 850 students at its navigation school at Coral Gables, Florida, during the period between August 1940 and December 1941. Plans were also made to train navigators at Maxwell and Barksdale Fields as soon as Air Corps schools could be set up at these stations. Since Maxwell was destined to be used for other training, it never functioned as a navigation school, but training did begin at Barksdale in November 1940, and by July 1941 this school had graduated three classes which totaled fifty-two navigators. This number, when added to the 287 graduated from the PAA school, was 410 short of the goal of 749 navigators that had been scheduled for 1 April 1941. Moreover, it was hardly a beginning on the new goal of 4,888 navigators per year which had been authorized early in 1941, and no increases in the numbers trained could be expected from the two existing schools. The trouble was that in May 1941 the British had been granted permission to contract for the training of 150 United Kingdom students per class at the PAA school, thus limiting the number of United States students per class to 50; and at Barksdale bad weather and the competition of other training programs made it impractical to expand the navigation courses sufficiently to make any real progress toward the new goal.[43]

In July 1941 a new tack was attempted. In lieu of schools devoted exclusively to navigator training, now recognized as essential but which were nonexistent, the Air Corps decided to operate navigation schools in conjunction with advanced pilot schools. To put this plan into effect, the school at Barksdale ceased to train navigators on 1 July, and its personnel was split three ways to form the nuclei for navigation schools at Turner Field, Georgia, Kelly Field, Texas, and

Mather Field, California, where navigator classes of about twenty each began their studies on 1 August, with succeeding classes scheduled to enter every three weeks. By 1 November 1941 it was obvious that this plan, too, was falling short of meeting the requirements set forth in training directives. These schedules had called for 1,269 navigator graduates by that date; but the total number of navigators that all schools—civil and military—had been able to train was 460. Various measures were taken during the rest of the year to energize the Air Corps' training program. In the Southeast Training Center plans were made to increase the size of classes at Turner Field, and a second navigation school was projected. The Gulf Coast Training Center planned to concentrate navigation training at Brooks Field, in order to overcome the handicaps under which the navigation program was forced to operate at crowded Kelly Field. And the West Coast Training Center expanded navigation training by removing the pilot school from Mather Field, thus permitting the navigation school to use the entire capacity of that station and increase the size of classes to 240 students. In March 1942 plans were announced for a new navigation school (Selman Field) at Monroe, Louisiana, to replace the one at Turner Field, and for another new school at Hondo, Texas, to replace the one at Kelly Field. The facilities at Hondo alone were planned for a student enrollment of 1,800, an indication that the days of halfway measures were over. Delays in construction and shortages of materiel and personnel, however, prevented these two new schools from starting training until late summer of 1942. By October of that year the navigation schools were reported to be going "all out" insofar as equipment would permit, but the record shows that it was 1944 before the navigation training program reached a production rate that would begin to match the requirements.[44]

There were no specialized flexible gunnery schools prior to 1941, and such training as was given was somewhat superficial and not highly specialized. Part of the difficulty stemmed from differences of opinion on armament equipment, differences which, the Chief of the Air Corps reported in 1935, affected almost every phase of flexible gunnery training. For this and other reasons, chiefly lack of funds, it was September 1940 before the Chief of the Air Corps initiated plans to establish specialized schools. The Southeast Training Center was then asked to suggest a course of study, and in the summer of 1941 a team of officers was sent to England to study the RAF gunnery system.[45]

Meantime, a site for what was to become the first flexible gunnery school was chosen in the Nevada desert not far from the town of Las Vegas. A lease was arranged with local authorities on 25 January 1941, troops to staff and man the post arrived on 17 June, and three classes of instructors totaling slightly more than 100 were graduated before war broke out. On 9 December 1941 the training of aerial gunners was ordered to begin immediately, and facilities were quickly expanded to permit classes to enter every week. In 1942 the Las Vegas school graduated 9,117 gunners; during 1943 the number of graduates was 18,071. Plans for a second flexible gunnery school at Harlingen, Texas, were approved by the War Department on 6 May 1941. Although school personnel reported to the post on 1 September 1941, training did not begin until after 7 December, and the first class did not graduate until January 1942. Harlingen graduates totaled 4,953 in 1942; 15,682 in 1943; and 4,009 during the first two months of 1944, the latter figure suggesting the rapid expansion of the school, since Harlingen had originally been designed to train a student body of 600, with a class of 120 graduating every week. A third site, which Army authorities planned to use for a flexible gunnery school, was Tyndall Field at Panama City, Florida. Arrangements were started as early as September 1940, but authority to set up the school was not given until 15 April 1941. Although troops arrived at the school before 7 December 1941, it was not until 23 February 1942 that classes began training. During the balance of the year 8,091 gunners were graduated. By 31 August 1944 this school ranked second to Las Vegas in number graduated, having a total of 39,452 compared with 44,246. In addition to these three schools, four others were established after hostilities began: at Fort Myers, Florida; Laredo, Texas; Kingman, Arizona; and Yuma, Arizona. By August 1944 the seven flexible gunnery schools were producing graduates at a rate of 3,500 per week or approximately 180,000 per year. They had produced a total of 214,826 gunners by 1 September 1944 in spite of many handicaps—including lack of planes, turrets, trainers, cameras, sights, and other training essentials; shortages of qualified instructional personnel; and the apparent inability of the planning echelons to make up their minds on student assignments to flexible gunnery classes.[46]

It had been assumed in 1938 that the Air Corps Technical School, with some improvement and extension of facilities, could take care of current objectives. Those objectives called for a force of 2,320 planes

and 24,968 enlisted men; estimates based on the assumption that 7 technicians would be required for each plane resulted in the round figure of 16,250 enlisted men that should receive technical training.[47] Chanute Field served as headquarters of the school and provided facilities for departments giving instruction in mechanics, communications, clerical work, and basic military training. The departments of photography and armament were situated at Lowry Field, an installation recently developed in Colorado. When legislation in April 1939 raised Air Corps goals to 3,251 planes and 45,000 enlisted men, with a presumed requirement for the technical training of over 22,000 men, OCAC moved promptly to enlarge the resources available for this purpose. First, as has previously been noted,* it contracted with civilian schools for much of the additional training that would be required. At the same time, it took an initial step toward expanding the Air Corps Technical School by transferring to its jurisdiction an old balloon school at Scott Field for use by the department of basic instruction. For a year training in several technical specialties was conducted at Scott Field while facilities at Chanute and Lowry were being expanded, and late in 1940, with the transfer there of the department of communications, Scott became a radio school exclusively.[48]

The trend of the European war in the spring of 1940 brought quick realization of the inadequacy of the existing program. In conjunction with officers of the War Plans Division of the General Staff, the OCAC drafted a series of plans,[49] two of which affected the technical schools, for a greatly expanded training program. The first of these plans, which became operative in July 1940 and was known as the WPD 2,726-airplane program, provided for an Air Corps enlisted strength of 94,415 men, and established a goal of 28,278 airplane mechanics to be trained by 1 January 1942. The plan contemplated no additional schools but would require that existing facilities be utilized at capacity. A second plan, substituted for the above in September 1940 and known as the WPD 3,873-combat airplane program, called for an Air Corps enlisted strength of about 135,000 men and established a goal of approximately 52,000 airplane mechanic graduates by 1 January 1942. Acceleration of the first plan, General Arnold was informed by his staff, could be accomplished by the expenditure of a million and a quarter dollars to increase the existing technical schools to maximum capacity, but he was advised that this

* See above, p. 461.

added capacity would produce only 40,531 graduates by 1 January 1942 and hence fall approximately 12,000 short of meeting the goal projected in the second plan.[50] To overcome the deficiency it was recommended that two new technical schools be established.

Confronted in July 1940 with the need for immediate acceleration of the technician-training program, OCAC shopped around for Army facilities that it could put to early use to augment its existing schools. The first accession was Jefferson Barracks, an old Infantry post, which was acquired on 30 July 1940, and to which the basic military training program for Air Corps recruits was shifted from Scott Field. This move freed facilities at Scott for mechanic and radio training. Then early in 1941 Fort Logan, Colorado, was acquired, making it possible to move the clerical school there to release facilities at Lowry Field for expansion of armament and photography training.[51] By this time a third over-all plan had set the training objective for technicians at a rate of 110,000 per year, with provision for recruitment of 11,000 men each month, beginning in July 1941.[52] Additional funds were secured for expansion of facilities at all three technical training stations and for the construction of two new aviation mechanic schools—Keesler Field at Biloxi, Mississippi, and Sheppard Field at Wichita Falls, Texas. These installations were ready in September 1941. In addition to serving as mechanic schools, they were also designated as Air Corps replacement training centers (subseqently redesignated as basic training centers) and, as the tempo of recruitment picked up in the fall of 1941, gave much-needed relief to Jefferson Barracks.[53]

These, then, were the facilities for technical training when war began. Geared to a training rate of 110,000 per year, they were to be expanded by the Victory Program in January 1942 to provide 300,000 technicians by 1 January 1943, and in September of 1942 additional facilities were made available that by June 1943 would provide technicians at a rate of 600,000 per year. This was the peak objective, a training rate that was reached in March 1943 when 62,000 students were entered in technical schools. By November 1941 students were entering the technical schools at a rate calculated to produce the desired 110,000 graduates per year.[54] At the close of that year the graduates trained since 1 July 1939 numbered 57,589. Of this total 1,588 had been trained in 1939; 14,375 in 1940; and 41,626 in 1941.[55] The figures were disappointing, but at least the groundwork had been laid for a more adequate program.

Administrative Adjustments

The heavy burden of the greatly expanded program for technical training had forced the Air Corps to establish a Technical Training Command in March 1941. Not only was the Air Corps Technical School at Chanute—which in addition to control of activities at Lowry, Scott, and Jefferson was responsible for supervision of fourteen civilian contract schools[56]—inadequately staffed and poorly organized for its heavy responsibilities, but the OCAC Training and Operations Division needed relief from its supervisory obligations. Staff officers there saw the need for early decentralization of authority in what was becoming an unwieldy organization of the schools, and as soon as plans for the 110,000-technician training program were assured, the Chief of the Air Corps directed the establishment of an Air Corps Technical Training Command.[57] Temporary headquarters for the new command was established at Chanute Field on 26 March 1941, with Maj. Gen. Rush B. Lincoln as commanding general. In September a permanent headquarters for the command was selected at Tulsa, Oklahoma, a move that relieved congested Chanute Field and which also enabled General Lincoln to gain a fresh perspective of his job.[58]

Further decentralization of authority was achieved by grouping the technical schools into two districts, each commanded by a general officer. In a functional arrangement which placed basic military and aviation mechanic training under one command and remaining specialties under another, the first district included Scott Field, Lowry Field, and Fort Logan; the second district was composed of Chanute Field, Keesler Field, Sheppard Field, and Jefferson Barracks.[59] The district organization was abruptly abandoned on 11 December 1941, but the principle of decentralization was revived on 10 March 1942, this time on a geographical basis, when it was announced that four technical training districts would function under the jurisdiction of the Technical Training Command. Headquarters for the first district was at Greensboro, North Carolina; for the second at St. Louis, Missouri; for the third at Tulsa, Oklahoma; and for the fourth at Denver, Colorado. Later, in November 1942, a fifth district with headquarters at Miami Beach, was created to supervise the numerous technical training activities in Florida. One other change had occurred in the spring of 1942 when the headquarters of the Technical Training Command was moved from Tulsa to Knollwood Field, North Carolina,[60] where

the facilities of a plush country club were converted for use by this command, now under the direction of Maj. Gen. Walter R. Weaver.

The advent of war had also turned the spotlight upon the urgent need for a further reorganization of flying training. The establishment of the three training centers had only partially accomplished the changes which certain OCAC staff officers had been urging since January 1940. Col. Walter F. Kraus, executive officer of the Training and Operations Division, on 27 June 1941 proposed to General Arnold through the Chief of the Air Corps that a flying training command be established and that its commander be responsible directly to the Chief of the Air Corps for the individual training of Air Corps pilots and other flying specialists.[61] The Kraus memorandum described the administrative ramifications inherent in the job of directing the tremendous expansion, reviewed the multitudinous and increasing responsibilities of the Chief of the Air Corps, and called attention to the discursive responsibilities of the chief of the Training and Operations Division who, in addition to directing the huge training effort, was involved in a wide variety of important staff functions which occupied much of his time. In the light of these considerations, it was suggested that the flying training program had reached such proportions as to require one commander unencumbered by other duties. It was stressed that in a period of two years the number of flying training establishments had increased from two to forty-five (including thirty civil contract schools); that airplanes at these stations had increased from 400 to 2,700; and that personnel had increased from 3,300 officers and men to 37,000 officers and men. Moreover, the scope of training had increased. Formerly, aviation specialists such as aerial navigators, bombardiers, and gunners had been trained solely within combat units; now they received individual training at special schools. Over and above these responsibilities, the Training and Operations Division had to provide additional facilities, equipment, and personnel for the British pilot-training program, which was itself four times the size of the entire Air Corps pilot-training program prior to 1939.

It was recommended that the proposed command be given jurisdiction over the Southeast, Gulf Coast, and West Coast Training Centers; that it be organized along general staff lines; and that its commander be given full authority and responsibility under the Chief of the Air Corps for the accomplishment of War Department directives

for training of pilots, navigators, bombardiers, observers, and other flying specialists. In short, the new command would serve for flying training in a capacity similar to that of the Air Corps Technical Training Command. Moreover, its establishment would be "an important step in effecting that decentralization which is so increasingly necessary for the accomplishment of the Air Corps expansion program." Months passed, however, with no action taken by General Arnold to implement the proposals of the Kraus memorandum.

After war broke out, the plan for establishing a flying training command was revived. The Kraus memorandum was resubmitted to General Arnold on 23 December 1941 by Maj. Gen. Walter R. Weaver, Acting Chief of the Air Corps.[62] Buttressed by his experience as commanding general of the Southeast Air Corps Training Center and as Acting Chief of the Air Corps, General Weaver declared that he had become firmly convinced of the wisdom of the recommendation. General Arnold's approval was given on 29 December 1941, and on 5 January 1942 the Chief of the Air Corps was authorized to establish the command. Shortly thereafter the War Department ordered Maj. Gen. Barton K. Yount, commanding general of the West Coast Air Corps Training Center, to Washington where he assumed his duties as head of the new command on 28 January 1942.[63]

A problem of major significance to the Flying Training Command during the early months of its existence was the best location of the permanent headquarters, since it was imperative that as many government agencies as possible be moved from the war-crowded capital. The first question that had to be decided was whether to move to a site near Washington, thereby having the advantage of close, quick contact with Headquarters, AAF or to a location which, because of its central position in regard to installations of the Flying Training Command, would permit better control and direction of the activities of the entire command. After weighing the two opposing factors, Yount decided that a location distant from Washington but central to its own activities was the best solution, and General Arnold gave his approval. Fort Worth, Texas, was chosen. The move there was made on 1 July 1942.[64]

The heavier burdens which came with the opening of hostilities had also forced the AAF to give new consideration to the problem of training in the combat units. Prewar developments had followed a

traditional pattern. The responsibility of flying and technical schools was to train men as individuals for the performance of specific jobs. Graduates were then assigned to GHQ Air Force units, where the last stage of individual training was completed in the transition to full combat equipment and where the trainee learned to function as the member of an air or ground crew and to cooperate with other such crews. The crews were formed into squadrons and groups, and by the procedures of unit training taught to work together. This unit-training activity, a phase of training no less important than the earlier one of individual instruction, was at the outset of war beset by a variety of difficulties.

The establishment of the Army Air Forces in June 1941, with control over the Air Force Combat Command (successor to the GHQ Air Force) as well as the Air Corps, had served to reduce in some measure the difficulties arising from the dual organization of Army aviation,* difficulties that were especially apparent in the development of the training program. But the AFCC, like GHQ Air Force before it, had many other duties to perform. The very location of its four air forces—the First Air Force with headquarters at Mitchel Field, New York; the Second at Fort George Wright, Spokane, Washington; the Third at Tampa, Florida; and the Fourth at Riverside, California—testified to the paramount importance of the defense mission assigned to each of them. Bases chosen for defensive reasons were often ill suited to training purposes, particularly at the more northern bases where snowfall might handicap flying or even prevent it for as much as fifty days out of the year. Training facilities were inadequate even at long-established air installations like Langley and March Fields. As late as the spring of 1941 it was reported that bombing ranges lacked observation towers and night bombing facilities; that there were no ground machine-gun ranges; that Link trainers were crowded into hangars and barracks; that bombing trainers were in short supply and there was no hangar space for those that were available. The list of shortages included machine-gun ammunition, maintenance equipment, signal equipment, cameras for scoring bombing results—the list could be extended almost without end.[65]

Such difficulties must be attributed in no small part to the unavoidable pressures of a constantly accelerating program of expansion. But these pressures were felt with double effect in the combat units be-

* See above, pp. 24–25.

cause the heavier responsibilities for training came as but one part of the new load imposed by the expansion program, and this without any real reduction of normal obligations. Training might be interrupted by orders to photograph Indian reservations, to make flight-checks of U.S. Coast and Geodetic Survey charts, or to put on reviews and demonstrations for higher authority. At the same time, it was necessary to provide for each cadet examining board a rated flying officer —a duty assignment that took men away from training assignments at a time when replacements were not available. Training was also being constantly interrupted by the draining of personnel to form cadres to staff the additional units being organized. The level of experience among enlisted men at GHQ Air Force stations sank low and remained at an unsatisfactory point for months on end. To add to the confusion at these stations, there came a steady influx of recruits who were without any basic military training.[66] These men had to be given during the first month of their enlistment the necessary training and the processing required by regulations. GHQ Air Force stations were also required in 1939 to establish trade-test units to facilitate the selection of enlisted men for technical training.[67]

By 1941, when the combat units began to receive large numbers of graduates of the accelerated training programs at Air Corps training centers, it was noted that these men were less well prepared—that they needed additional instruction in ground subjects and in the duties of officers. The Fourth Air Force complained that its training program was less than 25 per cent complete by June 1941 because Air Corps training schools had failed to send graduates in sufficient numbers to sustain the scheduled rate of combat training.[68] On the other hand, the First Air Force reported that it was receiving new pilot graduates and would start training them under an existing directive only to receive a new directive, before the training had been completed, requiring that the group be split up into new units. After this had been done, the amount of training equipment per group, in short supply even before the split, was so inadequate that unit training fell far behind schedule. All stations also reported serious shortages of qualified airplane mechanics, radio operators, and other technicians;[69] and the schools were short of textbooks for use in ground-school courses, particularly in such subjects as celestial navigation.

In April 1941 an attempt was made to resolve the difficulty of competing claims on the combat units by a directive requiring the four air

forces to be divided into fixed and mobile echelons. The fixed echelon was intended to act as a central training supervisor and was to carry on all normal administrative functions, with only minor participation in air operations and then only in the absence of the mobile force. The shortage of trained officer personnel was so acute throughout 1941, however, that it was impossible for the air forces to carry out this directive. During that year new calls for units and equipment to take up defensive stations in Newfoundland, Greenland, and Iceland, and for the reinforcement of garrisons in Panama and the Philippines, added further to the drain on the resources of combat units. When the coming of war brought new demands for dispatch of combat units overseas and for the employment of U.S.-based units in antisubmarine patrols, the situation required some division of function that would permit the domestic air forces to concentrate their efforts. Accordingly, late in December 1941 the Second and Third Air Forces were designated as training air forces—the Second to concentrate on producing bombardment crews and the Third to prepare the greater share of pursuit pilots. The defense mission was assigned to the First and the Fourth Air Forces with the understanding that their training responsibilities would be restricted to a minimum.[70]

Lessons from Combat—Real and Simulated

When he became Chief of the Air Corps in 1938 General Arnold thought that the weakest area in the entire air program was the air intelligence organization. The blame for this situation, Arnold contended, could be laid in part upon the lack of cooperation received from the G-2 section of the War Department General Staff; in part upon the Air Corps itself, which was tardy in recognizing the need to develop its own system of air intelligence.[71]

In return for the right to buy American planes, the British and French governments, and especially the British, agreed to make available to the United States data on their own equipment and procedures.[72] With the passage of time, this source of information came to be of great value to the development of AAF training and organization. As soon as war broke out in the fall of 1939, General Arnold sent Lt. Col. Carl Spaatz and Maj. George C. Kenney to Europe as combat observers. During the ensuing months these two officers supplied many accurate reports which affected Air Corps plans and preparations. In August 1940, after the Battle of Britain had begun,

more air officers were rushed to England to learn everything possible about British and German tactics in this first great battle for air supremacy. Later, in April of 1941, General Arnold himself went to England to observe the air war at first hand and to confer with RAF leaders and British government officials.

At first, no Air Corps agency existed for the evaluation of intelligence received except the Air Corps Board, a body already weighed down by other responsibilities. It did its best to incorporate the tactical and strategical lessons derived from the information received by making frequent revisions in Air Corps field manuals and technical manuals, and by publishing such material as the British "Hints for Fighter Pilots" for use in training and in educating combat personnel on how best to conduct specific war operations. Within the limitation of personnel available on the Air Corps Board, it functioned satisfactorily, but there was real need for the establishment of an intelligence division at the Air Staff level. A first step was taken in November 1940, when the OCAC Information Division was redesignated the Intelligence Division and the scope of its activities was correspondingly enlarged.[73] The division became A-2 on the staff of the newly organized Army Air Forces in June 1941 with responsibility for both assessment and dissemination of intelligence.

Of more significance perhaps for the AAF training program were the direct contacts encouraged by the increasingly close cooperation between U.S. and British staff agencies in 1941. Thus, as a step toward defining the training program for AAF gunnery schools, two Air Corps officers, Majs. William L. Kennedy and D. W. Jenkins, spent the summer of 1941 in Great Britain where they made an intensive study of RAF gunnery schools and of the aerial gunner in combat. Simultaneously W/C E. B. Beamish of the RAF, an expert on flexible gunnery training, came to the United States and visited each of the developing schools where he gave advice on methods, prepared syllabi for ground school and for firing, and gave more or less formal instruction to enlisted men assigned to teach in the first schools.[74] Another Englishman, W/C E. M. Donaldson, an RAF fixed gunnery expert, performed a similar task in his specialty. The RCAF likewise supplied the Air Corps with gunnery training outlines as a result of a visit to their schools by Air Corps officers during the summer of 1941.[75]

The AAF training program came to reflect many practices which British experience had shown to be necessary, particularly in the train-

ing of combat crews. An example suggestive of the extent of the AAF's indebtedness to the RAF is provided by the recommendations presented to the Air Staff in September 1941 by an American officer returned from an assignment to study British employment of the B-17. He recommended: 1) that crews should be trained together after reaching a certain point in their training; 2) that gunners should be more versatile; in the RAF the gunner was "a pretty important Brother"; in contrast, "we have assigned boys who can't be used on the ground"; 3) that radio operators should get gunnery training in addition to training in their specialty; 4) that crews should have more night training; 5) that the AAF should test for high altitude to insure that only men physically qualified would be assigned to high-altitude crews; and 6) that the AAF should consider adoption of the RAF practice of having three intelligence officers with each squadron to brief crews and question them on their return. Eventually, all these suggestions were incorporated in the AAF training program, although some of the changes could not be made until equipment could be procured and installed.[76] Col. Ira C. Eaker, after spending the month of September 1941 in England, urged upon his superiors the need for greater emphasis in the training program on gunnery, instrument flying, and night flying. He also commented enthusiastically on the effective use of motion pictures by the British for instructional purposes.[77]

The AAF also learned some valuable lessons from the Army maneuvers held in the fall of 1941. These maneuvers, in which 400,000 men participated, were by far the largest the Army had ever held in peacetime. They began in August and lasted until the end of November, extending over an area that stretched from Texas eastward to the Carolinas. In addition to the combat units of the Air Force Combat Command, air base groups, who were to provide first and second echelon maintenance, and certain air depot groups participated. The Maintenance Command looked upon the maneuvers as offering a chance to discover deficiencies in its existing system for these more highly specialized service units.[78]

A sudden decision to send air depot groups left little time for proper preparation before the groups were required to be at the scene of the maneuvers. After the 4th Air Depot Group had moved from Patterson Field to the Jackson, Mississippi, airport early in September, it was discovered that some tools and many spare parts were missing

even though fifty carloads of equipment had been shipped. Moreover, no provision had been made to relieve critical supply shortages by air transport. The blame for these faulty arrangements was laid to inexperience of the key personnel, almost all of whom were second lieutenants with no previous supply experience. Engineering officers, unfamiliar with existing Air Corps supply procedures, added to the confusion. To cap it off, the communications system was hopelessly inadequate—messages were delayed anywhere from two hours to three days. Maintenance difficulties, fortunately, were not so pronounced as supply, and of thirty-two wrecked airplanes reported to the 4th Air Depot Group, all but one were shipped to San Antonio for extensive repair. Those planes that could be repaired at the scene of the crash were worked on by civilian technicians.[79]

The Carolina phase of the maneuvers went off much better for the depot groups. Langley Field was the air base for the I Air Support Command, and Drew Field at Augusta, Georgia, served as the air base for the III Air Support Command. The 4th Air Depot Group moved by rail and motor convoy from Jackson, Mississippi, to Herbert Smart Airport at Macon, Georgia, early in October to service the organizations deployed in these areas. By now the supply system was operating with more efficiency—a thirty-day level of supplies being maintained at Langley Field, a ten-day level at Drew Field, and a twenty-day level at the air depot at Macon. Among the more important lessons learned by the service units engaged in the Carolina maneuvers was the danger of inadequate protection on the ground and in the air. Specifically, it was quite evident that greater antiaircraft protection as well as more ground troops were essential for defense of an airdrome. Experience had also demonstrated that a fighter unit should be designated to protect a base from attack by enemy bombardment; that transport units assigned to bases for the purpose of ferrying supplies to field combat units should be relieved from administrative and command functions; and that a mobile machine shop should be installed in a truck of not less than five-ton capacity for use by the materiel squadron of an air base group.[80]

The incisive criticisms voiced by observers of the maneuvers indicated faults of such significance as to make the training problem a formidable one. Lt. Col. Barney M. Giles reported to the Chief of the Air Corps on 3 October 1941 concerning the unrealistic nature of the exercises that he had watched. He felt that they should have included

the firing of guns, the dropping of bombs, and the testing of oxygen facilities for high-altitude flight. Giles also suggested, as did all observers, that air depot groups should include detachments from other branches of the service, especially weather, quartermaster, signal, ordnance, and engineer sections. First Air Force personnel felt that the maneuvers emphatically stressed the ground commanders' ignorance of the value of aerial photography. Few camera missions were requested, and First Air Force felt that this was the fault of officers who did not understand what was to be gained from photo intelligence. Similar comments were made at a conference called by the Secretary of War at the termination of the maneuvers. This meeting, held on 3 December 1941 and attended by the "top brass," was intended to highlight the lessons learned from the maneuvers, serve as a forum for the exchange of ideas, and enable those responsible for troop training to determine what aspects needed attention. Two points having to do with the participation of air units were brought out: one was the poor coordination between the tactical air forces and the ground units they were supposed to support; the other was radio communications from ground to air which, in General Arnold's judgment, were "awful."[81]

It was clear that the optimism which General Marshall had shown the previous April, when testifying before the Truman committee, had been premature. Neither the air nor the ground elements had achieved that degree of coordination which the Chief of Staff had then said was on the way. The primary reason, perhaps, was the unresolved question of the primary mission of the air arm. Was its main purpose that of assisting the ground forces in reaching their objective? Or was it to defeat the enemy air force and execute independent air missions against enemy ground targets? Proponents of the air force contention were convinced, as a result of their studies of the Battle of Britain, that Germany might be brought to her knees by air alone.[82] But these last prewar maneuvers clearly demonstrated that both sides in the air-ground controversy needed to be reminded of what the Germans had done in their campaigns on the continent. The Germans, observed General Marshall, had "introduced air as artillery on the battlefield . . . they coordinated a heavy bombardment preparation with a very rapid movement of ground troops," and thus gave a new application to a fundamental principle of warfare.[83] It was a principle that the Americans were to apply in a devastating way in the summer of 1944, thus giving ample proof that the lesson had been heeded.

The AAF Balance Sheet on the Eve of Hostilities

At the end of November 1941 the personnel strength of the AAF was just under 300,000. Included in this total were 22,524 officers and 274,579 enlisted men. The total strength of the AAF increased sharply in the weeks immediately after Pearl Harbor—the figure stood at 354,161 officers and men by 31 December 1941. At that time, there were 49¼ combat groups in the continental United States, and of these groups 20½ were engaged in operational training, 28½ were assigned to the strategic reserve, and ¼ of a reconnaissance group was in a manning phase.[84] As General Arnold was later to state for the record, the outbreak of war found the AAF "in low gear" but prepared to shift "into second"; when the Japanese struck, he noted, "we may not have had a powerful air force but we knew that we soon would have one. We had the plans, and our organization was growing every hour."[85]

This potential that General Arnold referred to was indeed reflected in the statistics for the previous two and one-half years of augmented training effort. By 31 December 1941 a total of 36,638 men had been graduated from flying training schools operated under OCAC's jurisdiction, and of that number 9,572 had already received their wings. Some of these officers had been retained by the training centers for duty as instructors, but the majority of them were completing their transitional or operational training in one of the four continental air forces; those that had already finished these later phases of training were serving with the Air Force Combat Command, or were overseas with a combat unit. Most of the total were pilots—9,030—but there were also 224 bombardiers, 181 navigators, and 137 nonpilot observers. The technical training schools had graduated 1,402 ground officer technicians, and 57,589 enlisted technicians.[86]

The Japanese attack came while the AAF was gearing its training system to meet the Army's Second Aviation Objective, the 84-group program. It established an annual production goal of 30,000 pilots, 5,590 bombardiers, 4,888 navigators, and 110,000 enlisted technicians. Authorized in March 1941 and initiated in October, this fourth expansion of the prewar training rate was launched, as had been the case with both of the 1940 expansions, before the goal of the previous program had been achieved. Thus when war began, many of the new bases and training facilities that would make this latest goal possible

of attainment were still under construction. The sudden turn of events meant that not only would these facilities have to be pressed into service at the earliest possible moment, but they would have to be vastly augmented. In many instances, training was scheduled to begin at these stations while the construction gangs were completing their job, and "it was not unusual to find a training field with dozens of planes flying above it, bulldozers on the ground finishing the earthwork, cement mixers turning out concrete for runways yet to be built, and men in the open still clearing the brush off what had been grazing land a few weeks before."[87]

Most retarded of the programs, as previously noted, were those for training specialist members of the aircrews. General Arnold, who was on the west coast when war began, held a hurried conference with Fourth Air Force officials and then ordered an immediate expediting in the training of bombardiers, navigators, turret gunners, and radio operators. His radiogram from Hamilton Field on the night of 7 December carried the injunction: "Insure that they are available in large numbers."[88] In response to another directive the Chief of the Air Corps prepared a revision of the 30,000-pilot program under which, by using existing facilities to the maximum, the production goal was expanded 24.6 per cent, thus making it a 37,000-pilot program. And before the end of December it was announced that planning was under way which would create "Army Air Forces that are relatively enormous as measured by past conceptions."[89] This was in reference to the three wartime pilot-training programs authorized in 1942 which would step up pilot production in stages—first to 50,000, then to 70,000, and finally to 93,000 annually, with corresponding jumps in technical training, first to 300,000, then to 475,000, and finally to 600,000 annually.[90]

A major problem of the training establishments during the previous programs, and one which the vastly enlarged wartime programs would aggravate, was the lack of experienced personnel. Instructor shortages existed at every level. Except in the civilian primary schools, all flying instructors had to be rated officers. It was considered feasible, however, to use civilians in the rapidly expanding ground-school phases of flying training, and during 1940 and 1941 ground-school instructors, most of whom were poorly qualified, were procured from several sources. Some were rated officers who were assigned to teach ground-school subjects without any consideration

of their teaching ability, some were civilians, some were enlisted men, and some were eliminated cadets with no professional qualifications whatever. Civilians were generally ignorant of flying and technical subjects, and many were not even teachers. Because of a general lack of understanding of the requisite qualifications of ground-school instructors, this early procurement policy was a failure.[91] Equally acute, because of the acceleration of pilot training in 1940 and 1941, was the shortage of flying instructors. To meet this situation, the Air Corps had followed a policy of assigning new graduates of advanced schools to instructional duties, but the number available from this source depended upon the demand for combat pilots in the tactical units. Many graduates who did receive assignments as flying instructors were poorly qualified, but because of the emergency they were used anyway. Graduates of Civil Aeronautics Administration courses constituted another source of flying instructors. Such men served almost exclusively in civil contract flying schools, but War Department regulations provided that if a graduate of a CAA pilot course could pass the Army service pilot test, he became eligible for commission and assignment as a flying instructor at an Army school. The rub here was that instructors obtained in this manner were handicapped by their lack of an adequate military background.[92] The shortage of rated pilot instructors was a serious bottleneck to a rapid increase in pilot training in December 1941.[93]

In the months that followed the Pearl Harbor attack, however, there was no question but that "the Army Air Forces *had* to become the largest single educational organization in existence in a very short time."[94] Recruitment of a "faculty" to staff such a huge training effort was a major undertaking, and one beset with pitfalls, as any college dean could have testified. And after the instructor personnel had been procured, the AAF discovered that it was, of necessity, in the teacher-training business as well, since many of those who had been recruited had to be "retooled" to qualify for teaching the AAF school curriculum. These and other problems concerning the individual instructor are discussed in the following chapter.

CHAPTER 15

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PROCUREMENT AT FLOOD TIDE

ON THE eve of Pearl Harbor AAF leaders were giving close attention to the policies which had theretofore guided recruitment. For the procurement of aviation cadets, chief dependence had been placed upon appeals to the youth of the country, with two years of college training as a minimum requirement for admission to the flying training program. For bombardiers and navigators the AAF had relied mainly upon eliminees from flying training, partly as a means of salvaging men in whom the Air Corps already had an investment. The same source supplied most of those trained as engineering officers and for other ground-duty assignments, though many of the eliminees failed to meet the higher educational tests established for admission to these programs. Volunteers, which is to say men who chose service in the AAF in preference to a draft call for duty in some other part of the Army, had proved sufficient to meet the need for enlisted men in the technical schools. But it was becoming all too evident that drastic adjustments of policy would be required if the greatly expanded objectives of the 84-group program were to be met. Those objectives, it will be recalled, had been set at an annual rate of 30,000 pilots, 5,590 bombardiers, 4,888 navigators, and 110,000 enlisted technicians.*

Renewal of the draft act in August 1941 had provided assurance that a sufficient number of apt young men could be procured for technical training. But two years of college as a prerequisite for admission to pilot training, it was becoming evident, imposed too rigid a restriction on the area of choice. Experience also suggested that the whole plan for training navigators and bombardiers needed review. These, especially the former, were subjects of anxious con-

* See above, p. 485.

cern to AAF Headquarters when war came. Outside that headquarters, the Air Service Command was struggling with its own peculiar personnel problem: the recruitment and training of a civilian staff to man its rapidly expanding depot system. And in the training schools it was becoming increasingly clear that the problem of procuring and keeping qualified instructors could become acute.

More Liberal Standards for Pilot Training

It had been recognized for some time that in the event of war it would be necessary to adopt less rigorous standards for the selection of pilot trainees. The requirement of two years of college had been a rule, easy to apply, that facilitated the rapid recruitment of men having a desirable background and capacity for flight training. But the number of college-trained men available, in view of the physical and other qualifications that were required, was too small to meet the schedules set by the 84-group program, and thus even before the opening of hostilities attention had to be given to lowering standards.

Training experts had for some time been convinced that high school graduates screened by special tests would probably provide better material for training as bombardiers and navigators than were the eliminees from flight training.[1] As a result, the Air Corps Technical Training Command had been directed in May 1941 to undertake the preliminary studies necessary for setting up an adequate system for bombardier and navigator selection.* For some time, too, flight surgeons at the School of Aviation Medicine had been conducting scientific studies of the physical and psychological characteristics desired in candidates selected for pilot training. In the spring of 1941 these officers requested and got a grant of $600,000 to be used in the development of aptitude tests that would indicate an applicant's general potentialities, practical judgment, and capacity to absorb instruction. The Medical Division of the OCAC was then authorized to recruit a "practical psychologist" and "suitable personnel" to staff this research program in pilot selection.[2] A project office for the purpose was established in the Medical Division on 14 June.† By the fall of 1941 it was obvious that the problem of pilot selection was but one of several interrelated questions, and the

* See below, pp. 546–47.

† For fuller discussion see below, pp. 545 ff.

Medical Division recommended on 19 November that responsibility for all phases of research and test development in connection with the selection and classification of flying personnel be lodged in its office.[3]

Four days earlier, Brig. Gen. Carl Spaatz, Chief of the Air Staff, had expressed his own conviction that the AAF would have to adopt a revised testing program. Labeling the existing system of educational requirements as "archaic" because it placed "too much emphasis on formal education which may mean nothing and . . . no emphasis on native intelligence which may mean everything," General Spaatz directed the AAF's A-1 to make a thorough renovation of the regulations governing the requirements for selecting flying cadets. This should be accomplished, he continued, by reconstructing the examination for flying cadet training so as to tap "such youth of the country as may not have had a full two years of formal education at college but whose intelligence and background (training, experience and otherwise) indicate that they can meet the requirements of a pilot officer in the Air Forces."[4]

The task of revising the regulations in compliance with Spaatz's directive was undertaken by the three OCAC divisions directly concerned—Personnel, Training and Operations, and Medical. At a series of conferences held between 28 November and 3 December 1941, agreement was reached on a new system for the selection and classification of applicants for flying training.[5] It was recommended that thereafter all applicants, on passing an aviation cadet qualifying examination to be prepared by the Medical Division, should be qualified simply as aviation cadets (aircrew), without designation as to specific training assignments. Specific assignments for those thus qualified would then be determined by special classification tests administered to all aviation cadets after they had been received at one of the three training centers. These tests were to be designed to measure the aptitude which each trainee had for pilot, bombardier, and navigator training, and would serve as one means of determining his type of training assignment. In order to put this second change into effect, a recommendation was made to the Chief of the Air Corps that the research project concerned with the selection of bombardier and navigator trainees be transferred to the Medical Division and combined with the pilot-selection project.[6]

Whatever doubts may have existed as to the action that would be

taken by the Chief of the Air Corps on these proposals were removed by the Japanese attack on Pearl Harbor. A change in procedure was no longer a matter for prolonged study—a decision was mandatory. General Arnold's reported injunction to Col. David N. W. Grant, chief of the Medical Division, on 8 December 1941: "You will have to start your processing right away," left no doubt that the new, more liberalized system for the selection and classification of aviation cadets would be instituted.[7]

On 10 December 1941 it was decided in conference between General Arnold and Brig. Gen. George E. Stratemeyer, Acting Chief of the Air Corps, that the following changes in recruiting and selection of aviation cadets would be made as soon as possible: 1) increase the number of aviation cadet examining boards; 2) give wide publicity to the recruitment program; 3) decentralize power to accept or reject aviation cadet applicants by relegating it to examining boards and authorizing them to enlist qualified applicants immediately upon acceptance; 4) authorize, as a substitute for the college requirements, use by the examining boards of an examination designed to test intelligence and ability to absorb training center instructions; 5) remove the ban on married applicants for aviation cadet appointment; 6) enlist all successful applicants as aviation cadets and assign them to aircrew training; 7) decide the type of training to be given to each individual after his arrival at an Air Corps replacement training center.[8] Some of these changes were instituted at once; others needed more time to effect. It was not until 15 January 1942, for instance, that the revision of the aviation cadet qualifying examination was officially approved by a special board appointed by General Arnold. Meantime, the new examination had been administered experimentally to approximately 1,000 aviation cadets by the psychological research unit at Maxwell Field during the early part of January 1942.[9]

For a period of about four months after the war began recruitment of aviation cadets was confused and uncertain. The sudden junking of most prewar procedures made it impossible for the OCAC to exercise over student flow the control which it had previously maintained by virtue of the fact that appointment to cadet status was made by The Adjutant General only after OCAC had reviewed all of the applicant's papers and had made a favorable recommendation to TAG. The new procedures authorized the examining boards

to take final action in most cases,* to enlist qualified applicants immediately as aviation cadets in the Army of the United States, and after enlistment, either to order the applicant immediately to an Air Corps replacement center, or to grant a furlough not to exceed thirty days, at the expiration of which the recruit would have to report at a designated training center. Another cause for the considerable confusion in the training centers was the apparent suspension of recruiting quotas for a short period after the war began.[10] Examining boards appear to have enlisted all applicants who could qualify, with the result that during the first three months of 1942 the influx of recruits for aircrew training was so great that Maxwell and Kelly Fields were swamped, and even the Santa Ana Army Air Base, construction of which had barely begun when the war came, began to receive trainees. At all three installations it was impossible for new construction to keep pace with the demands that the constantly increasing student population made upon the housing, messing, and training facilities. Each training center was forced to "farm out" to nearby airfields those aviation cadets whom it could not jam into its existing buildings or to house them in sprawling "tent cities" hastily erected to get men under cover.[11] When the training centers sought to have the flow stopped until such time as their facilities would permit them to cope with the increased load, one high authority at Washington warned on 23 January 1942: "Don't ever say you have a quota for aviation cadets."[12]

Steps to correct this situation were taken on 5 March 1942. As one means of getting an even flow of trainees, TAG directed the corps areas to restore a quota system on aviation cadet recruitment. But the overcrowding of the training centers was not the only problem for which TAG now had to seek a solution. The examining boards had also accepted and appointed as aviation cadets many qualified candidates who, because of the inability of the training centers to receive them, had been granted furloughs in accordance with the post-Pearl Harbor instructions. Under existing regulations, aviation cadets as soon as they received their appointments were entitled to receive $75 a month, plus a daily ration allowance of $1.00. Since no immediate services were being performed by cadets on a furlough

* The exceptions included applications from 1) colored men, 2) those who had been citizens for less than ten years, and 3) those who might need review by higher authority.

status, such a costly procedure could not long be justified. In an attempt to reduce this needless expense, TAG directed that aviation cadet recruiting officials adhere to the following procedure: either 1) assign aviation cadets immediately to training, or 2) have them sign an agreement to serve temporarily as Air Corps enlisted men, or 3) place them on furlough as privates. Furloughed men, when called to active duty, reported at assembly points designated by corps area commanders. There, before shipment, they were appointed as aviation cadets. This procedure reduced the expense and gave a measure of control over flow that was formerly lacking. By this time, too, a better system of coordination had been worked out between the AAF and the corps areas. Now, the training centers submitted requisitions to AAF Headquarters, the AAF then informed TAG of the number of cadets to be procured, and TAG allotted quotas to the corps areas. The corps areas, in turn, were instructed to send the application and allied papers of each cadet to the training center where the man was assigned. Previous to this change many cadets who arrived at the training centers could not be processed because their papers had been sent to Washington. These men had to "sweat it out" until their papers caught up with them.[13]

These various measures brought some order into the picture, but they did not solve the AAF's procurement problem. The relaxation of standards and the easing of rules and regulations governing aviation cadet appointment which were authorized after Pearl Harbor all aimed at maximum procurement. The AAF would need hundreds of thousands of applicants, and anything which discouraged men from applying, or complicated and confused the even flow of these men into training, would jeopardize the meeting of training goals. During 1942 and 1943 these goals were to be progressively increased. The 30,000-pilot training program had already been augmented by approximately 25 per cent since the outbreak of war, and the training centers had been notified that they were to step up trainee flow so as to produce 50,000 pilots per year, this rate to be attained before 1 October 1942. In January 1942 the pilot goal was raised to 70,000 per year, the schedule calling for sufficient entries into primary schools to attain this rate in March 1943. In October 1942 the planners were to set their sights on a figure of 102,000 pilots per year. Proportionate increases were to be made in the bombardier- and navigator-production goals.[14] The success of these training ventures

would depend, in the final analysis, upon the degree to which recruiting officials were able to keep up and increase the pace set in the early weeks of the war.

After 15 January 1942 TAG authorized corps area commanders and other commanding officers appointed by TAG to establish aviation cadet examining boards wherever they were needed and wherever facilities for their establishment could be made readily available. There were between two and three hundred of these boards functioning throughout the country by the summer of 1942. The number of traveling aviation cadet examining boards was also increased, and TAG authorized them to use large vans emblazoned with aviation cadet advertising. These units were an excellent advertising medium and, because they were highly mobile, could visit remote sections of the country. All trailers were equipped to give both the mental screening test and the physical examination.[15]

Other steps to increase the procurement potential included the lowering of the age limit for cadet training from twenty to eighteen years, a move authorized on 5 January 1942. This made available for flying training an age bracket which was not liable to the draft. Recruitment for aircrew training from the ranks of the Army, although limited to military personnel stationed in the United States, was also substantially increased after the war broke out.[16] The most important step taken to increase the procurement of aviation cadets, however, was granting authority to establish the Air Corps Enlisted Reserve.

The Air Corps Enlisted Reserve

The creation of a backlog of duly qualified applicants for aviation cadet training had been a paramount objective of the Air Corps since September 1940, when the Selective Service Act became law. The operation of the draft, plus the increased recruiting activity of the Navy and of industry, had put the Air Corps in a position where it feared serious competition for the type of young men that met its high physical and mental standards. The most practical way to insure against the loss of this potential aviation cadet personnel was to enlist qualified candidates in a reserve aviation cadet grade and place them on inactive status until such time as they would be called to active duty to fill training school quotas.

Two attempts were made in the prewar period to obtain permission for the creation of such a grade in an enlisted reserve corps, but

in each instance the request was disapproved. The opposition came principally from the Assistant Chief of Staff, G-1, who argued that the Air Corps would lay itself open to a charge of fostering a method of draft evasion, and from TAG, who argued that procurement was proceeding at a satisfactory rate and that the creation of such a grade would require long study within the War Department and the establishment of appropriate administrative machinery in each corps area. The fact that as late as 17 September 1941 the Air Corps had not yet appointed as aviation cadets a total of 6,500 qualified candidates who were on its list of eligibles undoubtedly militated against the proposal to create an additional personnel pool. Within two months, however, after the enlarged training facilities for the 30,000-pilot training program had become available, the qualified candidates were being absorbed in the training classes at a rate faster than recruiting officials could replenish the supply, a fact which prompted the decision to abandon the long-standing college requirement. After Pearl Harbor, when the stops were all pulled on recruiting, the number of men who applied and were accepted for aircrew training was so great that the Air Corps could not accommodate them, even at its expanded training centers. But training rates at the same time were being raised much higher, and the very confusion which attended current efforts to recruit and "store" the thousands of men who would be needed strengthened the argument for an enlisted reserve. Consequently, the request was made for the third time, and this time successfully. The Air Corps' contention that an arrangement of this nature was required in order to control the flow into training no longer needed to be argued, and approval was given to establish the Air Corps Enlisted Reserve (ACER) as of 1 April 1942. The recently reinstituted quota system was promptly abandoned and aviation cadet examining boards were expected to recruit enough men to insure a constant pool of 54,000 qualified applicants.[17]

Until mid-December 1942 all civilian applicants who could qualify for aviation cadet training were enlisted in the ACER pending a call to active duty. The plan was sufficiently flexible to appeal to men both in and out of school or college. To those between the ages of eighteen and twenty-six who could pass the physical and mental examinations for aviation cadet training, three courses of action were now open. Each applicant who qualified could elect:

1) to enlist for active duty as a private in the Army Air Corps (unassigned), earmarked for aviation cadet appointment and training as facilities became available; 2) to enlist in the ACER and remain at his civilian job until called to active duty, at which time he would receive appointment to aviation cadet status; or 3) if enrolled full time in an accredited college, enlist as a private in the ACER and continue in college until graduation or withdrawal, but with the understanding that the deferment could be terminated at any time by the Secretary of War.[18]

Because the colleges had long been the prime "hunting ground" for aviation cadet recruiting, the AAF lost no time in bringing the ACER plan to the attention of college groups. An intensive campaign was organized in the spring of 1942 which aimed especially at 150 colleges and universities throughout the country. All aspects of the recruiting drive were carefully worked out. A total of thirty-two special aviation cadet examining boards were appointed by the three training centers and the First and Second Air Forces, each board consisting of a senior air officer and a lieutenant who had recently completed his training. The presidents of the boards were all brought in to AAF Headquarters, where they were given an indoctrination course and briefed on how to achieve coordination with TAG and the recruiting activities of the corps areas. Letters went out to the college presidents asking their cooperation and inquiring as to the most convenient dates for the special boards to visit each campus. Details of the program were widely publicized in newspapers and college publications by means of advertising prepared by the firm of Geyer, Cornell, and Newell, which also compiled the portfolio of instructions used by the special boards. The campaign got under way on 24 April and continued until 30 May 1942. Two visits to each campus were made by a special board. The first visit was a promotional one, at which time talks were given, literature and pamphlets distributed, and a special aviation cadet training film shown at a mass meeting held on the campus. Actual recruiting was accomplished on a second visit which followed a week or two later. A report of the results of this special procurement drive, made on 15 July 1942, estimated that the mass meetings had attracted about 85,000 college students, that about 12,000 had shown interest in the program, and that 5,000 had already been enrolled, with many more candidates expected to make application during the summer months. In spite of the small initial sign-up, the campaign, it was felt, had succeeded in

establishing rapport with college students and college newspapers.[19] By autumn of that year so many of the colleges had established some plan for faculty advice to students on questions involving military service as to provide regular channels through which the opportunities offered by ACER could be kept before college men. The high schools and preparatory schools often provided similar advisory services for their students.

The goal of the AAF—a pool of over 50,000 enlisted reservists—was reached in the fall of 1942. Of this number about 10,000 had enlisted on the understanding that they would enjoy some period of deferment, usually until the end of the school term or year, although such deferment could not be guaranteed. In addition, there were about 20,000 enlisted men in the Army awaiting a call to aircrew training. The number of men being accepted each month for appointment as aviation cadets totaled 13,000, and since only 10,000 were being assigned to training, the pool of qualified candidates was growing at a rate of about 3,000 per month. The AAF defended this accumulation in the face of mounting criticism. Convinced that it must maintain at least a six-month supply of candidates to meet expected expansion schedules, the specter of losing men through the draft persuaded the AAF to continue a vigorous recruiting policy while simultaneously holding a large supply of qualified men in the ACER, some of whom were impatiently awaiting assignment. Reports of disaffection on the part of those who had left schools and jobs expecting an immediate call to duty were frequent. Thereupon public relations officers gave wide publicity to the fact that men might not be called for six months after enlistment, and candidates were cautioned not to leave their jobs or quit school until they received a call to duty. At the same time, assurances were given that the AAF would eventually have great need for the services of all men who had qualified for the ACER. Actually, within a period of less than six months an innovation in the training program and a tightening of the national manpower market resulted in the calling up of all men in the ACER pool.[20]

Recruitment for Technical Specialties

Because procurement goals for men to fill the aviation cadet ground-duty programs were small by comparison with those for the aircrew training programs, the AAF was confronted, fairly early in the war period, with a glut of men who had qualified, or who were

expected to be utilized, for ground-duty programs. In this particular instance, the creation of an unwieldy backlog was caused by a failure of aviation cadet examining boards to follow directives. As explained in an earlier chapter,* the educational qualifications for admission to the various ground-duty programs—armament, communications, engineering, meteorology, and photography—were higher than those for flying training programs, and the method used to check the adequacy of the applicant's background for a ground-duty training assignment had served as one means of controlling recruitment. In the prewar period all the papers of an applicant were carefully examined by the OCAC before the applicant was authorized to appear before an aviation cadet examining board. After the applicant had been accepted by an examining board, his papers were returned to Washington for a final decision. Under this system the Aviation Cadet Branch had a double check on candidates. The revised wartime regulations, which authorized aviation cadet examining boards to enlist aviation cadets immediately on approval by the boards without first sending their papers to Washington, were intended to facilitate the recruitment of aircrew candidates and specifically stated that ground-duty cadets were not to be so enlisted. Papers of ground-duty applicants were still to be sent to Washington for examination by the Aviation Cadet Branch, after which a request for enlistment of qualified applicants would be made to TAG. Despite these instructions, aviation cadet examining boards appear to have enlisted ground-duty cadets until 1 June 1942, at which time a new directive from TAG spelled out for the boards the specific procedure for enlisting qualified candidates for ground-duty training.[21]

By the fall of 1942 the results of overzealous recruiting had created a definite surplus of accepted ground-duty candidates awaiting training. The Aviation Cadet Branch reported in November that it had on hand an eight-month supply of engineering, a twelve-month supply of armament, a twenty-four-month supply of communications, and a twelve-month supply of photography candidates. The taking of applications for armament and photography training had already been stopped on 21 September 1942. Only in the meteorology and engineering programs was there a need for more candidates. After the termination of voluntary enlistments in December 1942, there was a search among enlisted personnel in the Air Corps

* See above, pp. 447–48.

for men who might be qualified for engineering and meteorology training. By May 1943 the need for these specialties had been more than amply supplied, and there was so large a backlog of candidates in all fields that all applications were being rejected. Thereafter, except for the temporary reopening of procurement in engineering and communications late in 1943, such applications as were accepted came mainly from top-ranking graduates of the enlisted men's courses in AAF technical schools. Procurement for aviation cadet ground-duty training ended officially on 29 March 1944, at which time it was announced that all existing quotas were filled.[22]

Candidates were procured for the aviation cadet ground-duty program from four sources. Eliminees from flying schools, the principal source in the prewar period, constituted only about 4 per cent of all ground-duty cadets. After the war began, eliminees found it more and more difficult to continue as aviation cadets for ground duty. Many did not have the requisite higher educational qualifications for ground-duty training assignments. Others were frustrated in the reassignment process when, through administrative bungling, their papers were lost. The general tightening up of applications for ground duty which came with the overlarge backlog in the fall of 1942 dimmed their chances still more, and the full quotas for training classes in the spring of 1943 virtually froze them out.[23]

Enlisted men in the AAF and in the ground and service forces of the Army constituted a second source of supply, and one which provided about half of the total number of candidates, but the bulk of these men did not enter the program until 1943 and 1944. The failure of the procurement system to make this training readily available to more enlisted men in the years before 1943 was the result of an unfortunate, but understandable, circumstance. Enlisted men who could qualify for aviation cadet training were discouraged from applying for appointment because their commanders did not want to lose them. The situation was brought to General Arnold's attention in May 1942, and he directed that high-quality men in the AAF should not only be recommended when they applied; they should also be encouraged to apply. This had the desired effect in the AAF, but in other branches of the service enlisted men who were qualified for ground-duty training continued to find it difficult to transfer to the air arm. As late as June 1943 it was necessary for TAG to direct that any enlisted man could apply to the local avia-

tion cadet examining board through his commanding officer, or if there were no board at his station, the application was to be sent to the commanding general of the local service command and thence to the board nearest the applicant's station. Having to go through channels was at times an effective hurdle used by other branches to prevent the AAF from raiding their enlisted ranks, and undoubtedly limited the number of men who might otherwise have requested and received transfers to the Air Corps.[24]

After the termination of voluntary enlistments in December 1942, recruitment of men for ground-duty cadet programs had to come almost entirely from enlisted men already in the service. The most fertile area for such recruitment in the AAF was among the graduates of the enlisted men's technical schools; during the first half of 1943 men were selected from the top 20 per cent of the graduates of certain courses. Once selected, local examining boards were authorized to accept the certification of commanding officers in lieu of the usual procedure of certification of educational requirements by the Aviation Cadet Branch.[25]

Despite the difficulties enumerated above, about half of the men who went into aviation cadet ground-duty training came from the enlisted men in the three branches of the Army. The other half came largely from the civilian population. The aviation cadet ground-duty program was also open to officers training in grade, but to a very limited degree. After war broke out, rated officers could apply only if they had been disqualified from flying duty for physical reasons. Officers from other branches of the service were a small though steady source of supply. After May 1943, because of full training quotas, few applications were accepted.[26]

By the time procurement ended early in 1944, a total of 29,321 men had been admitted to ground-duty training, 717 being officers training in grade. The number graduated from the various courses was 21,823, there were 4,577 more still in training, and 2,921 had left the courses either through elimination or transfer to some other field.[27] Three of the five ground-duty training programs—communications, engineering, and meteorology—had claimed approximately four-fifths of the total number of men assigned to classes. The ground-duty training programs, unlike aircrew training, had few eliminees. Elimination from a training course, when it did occur, was normally caused by lack of preparation, lack of interest, or personality difficulties.[28]

Recruitment of Civilian Personnel for Air Depots

In addition to the procurement of hundreds of thousands of men to fill its flying and technical training school quotas, the AAF had a special procurement problem as one of the nation's large wartime users of civilian labor. This was particularly true at the vastly expanded network of air depots, which at peak employment in August 1943 required a staff of upwards of 300,000 civilians. The use of civilian labor at air depots was not a wartime innovation. During the depression years laborers of the type required in aircraft maintenance and supply had been plentiful and cheap; many men had been glad to work for salaries of $1,220, $1,660, and $1,800 a year. Such training as was needed was accomplished on the job. After the Air Corps' expansion began in 1939, however, and as the depots began to hire in ever larger numbers, the depots found it advisable to establish apprenticeship training programs to speed up the training of new civilian maintenance personnel.[29] Such personnel were procured through civil service channels, and before 1941 only the top men of those who had passed the civil service apprenticeship examination were hired by the depots. By 1941, however, the depots faced a constantly dwindling stock of eligibles who could be procured from this source. Competition from aircraft factories, which were able to pay twice the salaries to junior mechanics that the depots could pay apprentices, doomed the program, and it was discontinued in October 1941.[30]

Meantime, starting in mid-summer of 1941, the depots had begun to avail themselves of funds appropriated by Congress for the vocational education of defense workers. These funds, administered by the United States Office of Education, permitted the depots to raise the training rate of civilian recruit employees in several ways: 1) by the establishment of a vocational school for use by a depot; 2) by the conversion of an existing public school in part or in full for depot use; 3) by the introduction of a new course or courses in a public or private school already in use by a depot; or 4) by the rental of space for the setting up of a new school or the expansion of an existing one. The depots procured the students, determined the content of the courses, and assisted the school in finding qualified instructors.[31]

The four older air depots—those at Fairfield, Ohio; San Antonio, Texas; Sacramento, California; and Middletown, Pennsylvania—

doubled the number of their civilian employees during 1940 and made further large increases in their procurement of civilians during 1941, when depot maintenance and supply activities quickened to keep pace with the 54-group and 84-group programs. By the end of November 1941 civilian personnel at these four installations totaled 25,999; a month later the figure was 31,292; at the end of January 1942 it stood at 38,526. Two new air depots, one at Ogden, Utah, the other at Mobile, Alabama, had also begun to recruit civilian workers.[32] On the eve of the war the Air Service Command likewise had fifty-seven subdepots in operation, each of which had an average of thirty civilian laborers.[33]

With the start of the war the Air Service Command began a vast expansion in the number of its air depot facilities, and since the War Department insisted that the command use civilian labor to the utmost, there was established a goal of 190,000 civilians to be procured for the depot program by the end of 1942.[34] The goal was achieved,* but procurement officials were hard pressed to fill their quotas. Hiring averaged 16,500 employees monthly during the first eight months of 1942, but the ASC found it increasingly difficult to compete with private industry and other government agencies. The majority of the air depots were located in areas from which war industry recruited heavily, and the labor market could not continue to supply trained workers in the numbers required. The depot program sought thousands of mechanics who could do airplane-engine repairing; subdepots alone, for example, each required a complement of approximately 200 general mechanics capable of doing third echelon maintenance; and workers were needed in large numbers for such jobs as parachute rigging, the storage and distribution of supplies, and the keeping of clerical records and correspondence. It has been estimated that approximately 60 per cent of those hired needed some training, and the rate of turnover was high.[35]

After the curtailment of production in the automobile industry, skilled mechanics became available for employment in limited numbers and in a few areas. With the rationing of gasoline, the more skilled service station attendants were sought as junior aircraft mechanics, aircraft engine mechanics, electricians, and sheet-metal

* Civilian employee figures for the ASC show the rate of growth to have been as follows: 40,432 employed on 31 December 1941, 81,105 on 31 March 1942, 135,568 on 30 June 1942, 164,496 on 15 August 1942, and 212,000 on 1 January 1943.

workers. But the numbers in these categories were far too few to meet the need, and by the summer of 1942 the depots were up against it: there was no choice but to use large numbers of female workers.

As early as January 1942 the Air Service Command had foreseen this necessity, but proposals for the employment of women in the depot program had run headlong into the opposition of those who considered women qualified only for clerical and certain administrative jobs. Responsible officers feared it would create jealousy if women were used on jobs traditionally held by men; they said that women in slacks would be an object of curiosity, that women would attempt to use their wiles to get out of doing unpleasant jobs, and that women were not mechanically minded; they contended that men would refuse to work under women supervisors; and they expressed a fear that women would show a tendency to leave jobs after the novelty of the work wore off. By the early summer of 1942, however, the ASC became insistent on compliance with directives listing fifty-one different positions, many of them requiring mechanical or other special skills, which women could fill as well as men. As a result, the employment of women increased rapidly during the second half of 1942.[36]

Reports from some of the depots soon belied the fears that had been expressed by those who opposed the use of women. At the Spokane Air Depot over 3,000 women had already been hired by June of 1942, and depot officials were considering the creation of a post analogous to that of a dean of women in a university to help with morale problems peculiar to women—an idea later adopted throughout the ASC. The Mobile Air Depot reported that it found a fair proportion of the women it employed to have definite mechanical aptitude and that for certain jobs women were better qualified than men because their fingers were more nimble. In spite of initial prejudices, the number of women workers had increased very rapidly by the end of the year. ASC employment figures as of 31 January 1943 showed that 77,780, or 35.7 per cent of the total civilian personnel of 218,149 in domestic installations, were women.[37]

Use of female labor became even more significant at the depot facilities during 1943 and 1944 as the armed services made increased inroads on the nation's supply of men. The high point for ASC was reached in June of 1944 when 45.8 per cent of its total civilian labor

force consisted of women. At no time during the war years, however, did any of the area commands reach the goal of 60 per cent women employees which ASC headquarters had suggested in April 1943. Only in two depots, at Spokane and at San Bernardino, did women ever amount to as much as 50 per cent of the total labor force.

On the question of their competence in jobs which previously had been done exclusively by men, the evidence, though it can hardly be viewed as free from bias, is nonetheless suggestive. Women proved themselves very adept at machine work of all types; exceptionally proficient in precise and delicate work on small parts where manual dexterity was involved; generally quicker and less easily tired in repetitive operations than men; more eager to learn; and diligent to apply themselves to the job at hand. Contrariwise, official reports affirm, women demonstrated that they were not as capable as men at benchwork; were slower at learning to use a hammer and chisel skillfully; were not as competent as men in analyzing situations, such as the procedure necessary in repairs; did not have as much initiative as men—when finished with one task, they would wait idly until assigned another. Women also had a higher absentee rate because of sickness.[38]

Physically handicapped persons by late 1943 were also being employed in large numbers.[39] The initial use of handicapped individuals had been made on an experimental basis by the Mobile Air Depot in July 1942. So quickly did this small group of workers prove its ability that orders were issued to hire more and more of them. The range of employable persons at this and other depots was gradually increased as it became clear that many previous beliefs as to the limitations imposed by physical handicaps were not valid. By June 1944 those afflicted with the following handicaps were being given an opportunity for work at a wide variety of tasks appropriate to their particular abilities: blindness and defective vision, deafness, physical deformities, cardiac conditions, rheumatism, arthritis, amputated limbs, arrested and active tuberculosis, and venereal disease.

In assignment to a job it was necessary, of course, to treat each handicapped person on an individual basis in order to insure that the worker was placed on a job in which the effect of his handicap would be minimized. Deaf persons, it was found, could be placed in almost any job where there were no traffic hazards, and they were

used as shop repairmen, carpenters, painters, laborers, storekeepers, and engine-installation mechanics. Benchwork was given to the majority of persons with lower-limb disabilities. Those with amputation or limited use of one hand or arm became radio operators, messengers, time-lock repairmen, motion-picture-projector operators, and mechanics in certain departments. Individuals who wore a hook were placed in warehouses as storekeepers and handlers of materials. Clerical and semiclerical jobs were given to cardiac cases, and persons afflicted with rheumatism and arthritis received jobs selected with regard to the degree of limitation imposed by the handicap. In the placement of tubercular cases there were three restrictions imposed: no heavy work, no night work, and no work where the air was polluted by dust or fumes. In addition, every tubercular employee was required to report regularly to a clinic. If it was found that the employee was endangering either himself or his fellows, his services were immediately terminated. Venereal-disease cases were required to show evidence that they were noninfectious and to bring periodic reports of continued treatment. The blind, after being given special training based on aptitude tests for mechanical ability, proved to be satisfactory in such jobs as that of sorter, starter and generator mechanic, storekeeper, packer of small parts, carpenter, airplane-engine mechanic, dictaphone operator, inspector of ball bearings, painter and inspector of machines.

Neither the use of female labor nor the employment of handicapped persons, however, could come anywhere near supplying the ASC with a sufficient number of skilled workers for the maintenance departments of the air depots. The obvious remedy was to recruit the unskilled and train them for these jobs, and in the weeks just before Pearl Harbor the air depots had sought authorization to establish training programs of this nature. One plan, authorized by the Civilian Personnel Division of the War Department on 30 October 1941, provided for training junior mechanic learners in the engineering sections of air depots at a salary of $600 a year. The other approach to the procurement problem, approved by the Secretary of War on 14 November 1941, called for the temporary establishment of a position as student trainee at a pay of $360 per annum. Whether these salaries would have sufficed to attract trainees in any appreciable number is open to question. But the advent of war brought the problem into sharp focus, and by February 1942 a uniform policy

had been established for all depots. The ASC was now authorized to hire mechanic learners at $900 per annum and train them for periods up to six months at any educational facility that was available and suitable. Some depots reported continuing difficulty in recruiting student trainees at the salary authorized, and by 31 August 1942 the depots had been authorized to fix the salary for mechanic learners on a range from $900 to $1,200 per year. Some depots also adopted the practice of granting a $6 per diem for the first thirty and $3 for the next ninety days of the training period, when the training was done at schools located some distance from the depot. The legality of paying pre-service trainees a per diem was soon questioned, however, and this practice was discontinued in January 1943, except for time spent in travel at the beginning and end of the training period.[40]

The pre-service training carried on by the Air Service Command for its depots was accomplished for the most part at three different types of schools: off-reservation, contract, and post schools. Peak enrollment was reached in August 1942 when there were 13,442 enrollees receiving training. During this year the bulk of such training was done at off-reservation and contract schools, but late in 1942 there began a marked trend to close out these facilities and expand the mechanic learner training at post schools. A year later, after procurement had been slowed down by a freeze on civilian strength ordered on 31 August 1943, there was only a small number of off-reservation and contract schools left in operation and most pre-service training was given in the post schools.[41] Since there were marked differences in these three types of schools, a brief statement about each is in order.[42]

Off-reservation schools, used almost exclusively for training in basic maintenance work, could be either public or private vocational schools, taken over in whole or in part for depot training, or set up for such training by a state board for vocational education. Since the schools were financed by federal training funds, and were directed, supervised, and controlled by a local or state board, the arrangements for inaugurating an off-reservation school were drawn up in the form of an agreement, rather than a contract, between the board and a specific depot and its subdepots. The depot provided the curriculum and training aids, determined the number of employees to be trained by periods of time, selected and assigned the trainees,

could dismiss or withdraw paid trainees from the school, and lent equipment, materials, and parts that might be needed in the training program. Off-reservation schools had certain advantages over other types of schools that offered this training. Most of them were staffed with experienced vocational school instructors, and since their funds were not encumbered by War Department red tape, off-reservation schools could procure additional instructors when needed because they were able to pay them well.

In the case of contract schools, the arrangement was similar to that employed by the Technical Training Command. A contract was drawn up by an AAF agency with a private institution, such as the Chicago School of Aeronautics, whereby the AAF agreed to assign a stipulated number of students per week for a course of instruction that ran for 15 weeks, or for 600 hours. The tuition for each student, paid out of AAF funds, amounted to $231. In the case of eliminees, the contractor received 38½ cents per hour of actual instruction. Each depot was allotted a weekly quota of students who were to be recruited in the depot area and sent to the contract school for training. The depot placed such students on its own payroll, and after graduation the trainee returned to the depot of origin for employment. Contract schools were authorized to recruit students on their own responsibility whenever the depots failed to send enough students to fill training classes that were scheduled. In such instances the trainee, who was carried on the Fairfield Air Depot payroll while in school, was required to sign an agreement that he would serve at any depot in the United States after graduation.

A post school was one located on a military reservation and administered by the training department of a depot. It gave instruction in those types of training which could not conveniently be given elsewhere. Supply training, for example, was quicker and more efficient when given in actual warehouses where the trainee could become familiar with real stock and stock procedures. Likewise, advanced maintenance training—which required recently developed, or depot-fabricated and still comparatively rare equipment—could best be done right at the depot. Post schools encountered more difficulty than others in procuring instructors, since depot salary scales could not match those paid by off-reservation and factory schools. The only recourse in such instances was to set up instructor-training courses at a depot. This practice had its advantages, since the

shops were accessible for the learning of special skills, and the instructor trainee could receive an orientation course in depot practices and procedures in conjunction with his instruction in teaching methods and skills.

Depot personnel were also sent to a fourth type of school for training—the factory school. A factory school was one originally set up and operated by a manufacturing plant principally for the training of its own employees, and the ASC on occasion found it advisable to send some of its employees to such a school for training in the maintenance of specific equipment. The use of a factory school for such instruction might occur whenever it was determined: 1) that the depots had inadequate facilities and lacked instructors; 2) that such a limited number of personnel were involved that it would make training at a depot uneconomical; or 3) the equipment was new or secret and only factory personnel were qualified to offer instruction. Because factory school graduates would return to a depot to give instruction to other personnel, these trainees were carefully selected maintenance personnel with previously demonstrated proficiency in their particular line of work.

The measure of success which the ASC achieved in supplying its civilian personnel needs through resort to the mechanic learner program can most conveniently be expressed in terms of the number of students trained. In the period from January 1942 through December 1944 a total of 137,200 inexperienced men and women passed through these programs and were at least partly qualified for work in ASC shops, warehouses, and offices.[43] Thus by adapting its procurement policies to take advantage of those sources of labor—women, the handicapped, and the unskilled—that were not in such short supply, the Air Service Command was enabled to meet its procurement quotas.

Instructional Personnel

Perhaps no personnel problem which faced the AAF during the war years caused more difficulties than that of instructors for its schools. With flying training, which necessarily was largely individual, the difficulty mainly was one of supply. To meet the growing demand for qualified instructors in an enormous expansion of the training program, while meeting the no less imperious demand for experienced personnel to man the many new combat units, was not easy, but fly-

ing instruction was on the whole satisfactory. In contrast, group instruction—particularly in such ground-school subjects as navigation and aircraft recognition—left much to be desired. The idea that teaching required special qualifications and its corollary, that not everybody could teach, were not generally understood in the AAF, and the problem of procuring qualified instructors for the training program never received proper attention. The difficulty was primarily due to long-established military usages. Traditionally, any officer by definition was a qualified instructor, an impractical assumption at best and one that could be hazardous. Traditionally, too, the student carried the main responsibility for mastering the subject taught in ground school after formal presentation in the classroom, however imperfect the presentation might be.[44]

So long as it continued to be possible to assign experienced flying officers to ground instruction, there had been some advantage in the older methods of assignment. Flying officers viewed their function as ground-school instructors in the light of their own flying experience, and when the instructor had any of the gifts of a teacher, his presentation of the subject matter was effectively related to actual conditions encountered in flying. But the sharp rise in the number of flying schools now made it necessary to tap other sources to augment the ranks of ground-school instructional staffs. Some, though by no means all, ground-school courses were taught by enlisted men and eliminated cadets, most of whom were not qualified as teachers. The AAF turned also to the employment of civilians on civil service lists to teach certain subjects in the ground-school curriculum. Many of those employed had been teachers, but some of them were marginal teachers at best or were men who, having failed at teaching, had gone into other occupations. With the possible exception of those hired to teach mathematics and physics, these civilians lacked knowledge of the subjects to be taught, and they had little or no understanding of flying.[45] Although such individuals could and did "bone up" on aviation matters, they did not thereby necessarily become better teachers, and the training centers worried along until well into 1942 before concerted efforts were made to recruit a large staff of professional teachers, men possessed of high educational backgrounds and skilled in the art of teaching.

As soon as war began, the supply of instructors in all categories decreased. Flying instructors in particular were in short supply at all

levels. Primary schools relied exclusively, and basic flying schools to a more limited degree, on civilian flying instructors.* Some of the key personnel at the primary schools held reserve commissions, and contractors were warned as early as 22 December 1941 that reservists could expect calls to active duty by 15 March 1942. Partly in the hope of avoiding too serious a disruption of primary training schedules, procurement of civilians with extensive aeronautical backgrounds was begun in March 1942 in accordance with an agreement reached between the Civil Service Commission and the War Department whereby such men would be hired as pilots at $3,600 per year. These men would then be sent to an AAF central instructors school where they would be trained and observed for qualifications as military pilots and officers and, if found qualified, be commissioned directly in the Army of the United States with ratings as service pilots. Experience soon demonstrated that only 40 per cent of the men so hired could qualify for commissions; these officers were then assigned to basic flying schools, or to duty as utility pilots. The 60 per cent who failed to receive commissions were offered employment as flying instructors at primary schools or at glider schools. By the fall of 1942, however, procurement had slowed down because men who could qualify for service pilot commissions were already either in the service or in some other war activity in the aviation field. Thereafter, the training centers concentrated their recruiting efforts on civilian employees at primary schools. Commissions as captains were given to the more experienced flying instructors at the contract schools, and they were then assigned either to basic schools or reassigned to primary schools as Air Corps supervisors. Replacements for personnel lost by the primary schools through this policy were to be obtained through the Civil Aeronautics Administration which had agreed in April 1942 to qualify 2,000 flying instructors for the three training centers.[46]

Primary schools also faced the constant threat of losing their civilian instructors either to the draft or to the Navy. Despite repeated assurances by the Director of Selective Service that deferments would be granted to key personnel, local draft boards continued to pull men out of the primary schools all during 1942. When the AAF suggested, as a means of protecting the contract schools, that instructors be granted direct commissions, the Secretary of War refused on the

* Many civilians were reluctant to instruct in military aircraft at basic schools because of nonavailability of life insurance.

ground that such a policy would vitiate the plan to put everybody who aspired to commissioned status through officer candidate school. The contract schools likewise suffered from constant Navy proselyting of instructors, an action that the AAF considered as a violation of an agreement made on 12 June 1942 not to engage in personnel raids. But there was a loophole in the stipulation that the ban applied only to personnel under contract, and primary school contractors showed reluctance to put very many of their civilian instructors under contract for fear of being saddled with employees who might become surplus at any moment. The reasons for this were obvious, since the government had reserved the right to terminate contract flight training on twenty-four hours' notice, and Army supervisors could demand the release of any contractor's employee for suitable reason. As the Navy had no contract schools, it was in a position to bargain with impunity and seldom failed to obtain an instructor it set out to entice. The War Department, in a belated move to aid the civilian school contractors, on 8 September 1942 authorized the enlistment of civilian flying instructors in the Air Corps Enlisted Reserve. The purported theory behind this policy was that enlistment would obviate the necessity to get and keep a draft deferment. The instructors were blandly assured that the step would not prevent a reservist from applying for a commission at any time that a contractor agreed to release him. Only about a third of the civilian flying instructors, however, accepted this offer. The studied refusal of the Secretary of War to relax his position on direct commissions for instructional personnel at the contract schools pleased only the Navy, and that service continued to find the primary schools a lucrative field in which to recruit good prospects for direct Navy commissions.[47]

As the experience of the primary schools would suggest, the AAF's own training schools found flying instructors in short supply. Even though the vacancies could be filled by the expedient of assigning recent graduates to a tour of duty as instructors, the training centers were hard put to stay within the maximum advisable ratio of instructors to students because of the constant removal of rated personnel to fill combat-crew requirements. The preferred instructor-student ratio in various flying categories was as follows:

Basic training: 1 instructor to 5 students
Advanced single-engine training: 1 instructor to 5 students
Advanced twin-engine training: 1 instructor to 2.5 students
Flexible gunnery schools: 1 instructor to 6.7 students

Since the instructor rode with the student until the latter either learned the flying techniques of a particular maneuver or was eliminated, the best results were achieved when these ratios were not exceeded.[48]

Efforts to recruit ground-school instructors in the numbers and quality desired began early in 1942 and continued at an accelerated pace until mid-1943. The training centers now did what they had failed to do earlier—they set out to recruit "highly trained pedagogues." College and university faculties over the nation were combed for men of draft age who would agree to accept temporary appointments as civilian instructors in the ground schools, on the implied assumption that such employement in an essential job might qualify them for possible draft deferment, and with the idea that this connection with the Army would smooth the way to a possible commission. During the spring and summer of 1942 many of these men, if over thirty years of age, did receive direct commissions, were sent to officer training school for six weeks, and then returned to their teaching assignments. For those under thirty, the Southeast Air Corps Training Center made arrangements with the IV Service Command in the fall of 1942 whereby civilian instructors were enlisted at Maxwell Field, then sent to officer candidate school where after a few days the enlistee appeared before a board and was commissioned. Before the other training centers could take advantage of this short cut, the practice was stopped late in December 1942, but not before fifty instructors from Maxwell Field had got through.[49]

The Gulf Coast Air Corps Training Center used an even more direct approach to obtain professional educators. It sought and obtained authorization to commission college professors as ground-school instructors "in grades consistent with their qualifications and civilian income."[50] As a result, this training center established the so-called Snyder Board,* which canvassed the colleges and universities of the central states and appointed approximately 500 men as first and second lieutenants between May and September 1942. When it was ascertained in the fall of that year that an additional 335 instructors would be needed to meet the requirements of the 75,000-pilot training program, this training center received authority from Robert Lovett, Assistant Secretary of War, to continue this procurement.

Before the second Snyder Board had actually begun its recruitment,

* Its members consisted of Lt. Col. Alva W. Snyder, Lt. Col. Jergen B. Olson, and Maj. Gaylord Johnson, all of Ellington Field.

however, the Secretary of War authorized General Arnold on 3 November 1942 to establish a procurement objective of 1,000 officers (400 first lieutenants and 600 second lieutenants), with the limitation that appointments were to be given only to persons qualified as instructors in AAF training schools in one or more of twelve listed subjects.* Each of the three training centers was allotted 333 instructors and cautioned by the commanding general of the Flying Training Command that no nominations should be forwarded unless the applicant was already employed in a ground school, or in an accredited college or university, and was at least thirty years old.[51]

Each training center proceeded to appoint an officer procurement team which toured the colleges and universities in its respective geographical area during the months of November and December 1942, interviewing, investigating, and selecting qualified applicants for commissions. It is evident that these procurement teams, particularly the second Snyder Board, made some unjustified, not to say unethical, promises to faculty men during their conversations on the various campuses. The number of those commissioned under this particular procurement authority as first lieutenants fell short of the 400 authorized. Moreover, all ground-school officers whose duty assignments put them into the classroom soon discovered that they were at the very end of the promotion list with little or no hope of advancement. The result was great frustration and morale problems detrimental to the welfare of both the men concerned and of the ground schools where they were assigned.[52]

In the West Coast Training Center efforts to commission approximately 300 civilian ground-school instructors who were employed at the Santa Ana Army Base preflight school and at certain primary schools ran into one snag after another during the fall of 1942. Most of these men had applications for commissions pending when orders from Washington put a stop to the processing of the applications. Since many of these instructors had only temporary draft deferments, it was obvious that the training center stood to lose an increasing number of these men to the draft unless they were brought into the AAF. The plan ultimately adopted provided for enlistment of all instructors with draft classifications below 3-A and immediate promotion of these enlisted instructors to ratings as noncommissioned officers. Thereafter, applications for direct commissions were to be pre-

* Mathematics, physics, meteorology, radio, navigation, history, maps and charts, photography, cryptography, and automotive, electrical, and mechanical engineering.

pared and processed for a small number of those enlisted who were over thirty-four years of age, the appointments to be charged to the training center's allotment under the 1,000-instructor procurement goal. Most of the instructors who were enlisted in November 1942, however, were under thirty, and these men were required to go to officer candidate school. They were sent in groups during the period from December 1942 to June 1943. Of the total of 242 instructors sent to Miami Beach by the West Coast Training Center, only 200 were returned, the balance being assigned to duty at other training centers.[53]

By 1943 the bulk of the ground-school instructional personnel in all three training centers had been put into uniform. The Flying Training Command now decided that the time had come to standardize instruction in the ground-school programs, which had begun to vary between training centers and even between individual schools within a training center. Each training center had been attempting, in one form or another during 1942, to provide some kind of indoctrination and in-service training for its instructors, some of whom had had very little military training because of the great need to keep them in the classroom. Many more were teaching subjects such as navigation, meteorology, theory of bombing, and aeronautical engineering, for which their educational background and experience had not prepared them. The method of solving this problem was the establishment of a ground-school curriculum in the central instructors school at Randolph Field. Each training center was allotted a quota for classes that were to be entered every eight weeks starting in March 1943. Ground-school instructors assigned to the central instructors school were to major in weather, navigation, armament, and bombing courses, with supplementary training in aeronautical equipment, identification, teaching techniques, radio code, and military procedures.

At its inception the central instructors school appeared to be the answer to the problem of instructor training. Graduates of the school, it was expected, would become multipurpose instructors who could be assigned to teach in any field where teacher shortages suddenly developed. The major trouble was that the program came too late. Moreover, many instructors were thoroughly disgusted with the training they received there. Instructors who were assigned to the early classes quickly spread the word about the nature of the training they received, with the result that many stations contrived to assign

only their weaker instructors when called on by the training center to nominate men for these central instructors school quotas. In time the training centers themselves began to stress in-service training at the school level as being more practical and economical. The Western Flying Training Command, for example, advised its stations in August 1943 that during periods of light loads, instructors should be assigned to one or more of the following duties: 1) training in another ground-school subject; 2) further study in the subject or subjects presently instructing; 3) study of intelligence material which might be incorporated into their instruction; 4) review and improvement of daily lectures; and 5) the development of training aids.[54]

Although enlisted men were used in various schools of the Flying Training Command to instruct in such subjects as radio code, most enlisted instructors in the AAF were in the schools of the Technical Training Command. The instructor problems at these schools, aside from procurement, revolved around two things—tenure and promotion—with their attendant effect upon morale.[55] Procurement of enlisted instructors was accomplished in most instances by the expedient of selecting men from the graduates of technical training school classes, and often this was done without regard to whether the enlisted man wanted such assignment. Normally, those selected were chosen because their records indicated a good educational background or because they had scored high on the Army general classification or mechanical aptitude tests. Unless pressure to meet training quotas dictated that they begin to instruct immediately, men selected for duty as instructors were given a special course in teaching techniques before assignment to the classroom.

Many civilian instructors were also employed at the technical schools. Procurement of civilians with appropriate professional and technical skills was accomplished through civil service channels as long as this was practical; when this source failed to produce enough qualified candidates, resort was had to training and up-grading of the less skilled. Losses to the draft, to the Navy, and to other agencies, was a constant threat, and some schools lost as much as 50 per cent of their civilian instructors from these causes. Moreover, use of civilian instructors in the same program where enlisted men were also teaching was a source of friction. Enlisted personnel, especially when not promoted, were jealous of the higher wages received by civilians, and they resented the civilians' draft exemptions.

The Manpower Crisis of 1943

Late in the autumn of 1942, as the nation began to feel the full impact of the drain which the war was making on its manpower, the President and the Congress made two moves that posed a serious threat to aviation cadet procurement. Both actions were necessary in order to enlarge the pool of military manpower and to insure that all branches of the armed forces would continue to get a fair share of the available supply. Neither move was aimed at the AAF's cadet program, but both actions turned out to be "direct hits." The first blow fell on 13 November 1942, when the Congress lowered the draft age to include eighteen- and nineteen-year-old men. Since February the AAF had been focusing much of its recruiting publicity on this age group, into which the draft would now cut deeply. The second blow came on 5 December when the President by executive order terminated all voluntary enlistments, effective after 15 December 1942. After that date, unless an applicant for flying training was already in the Army, he could be reached only through selective service procedures.

The AAF had good cause to be concerned over the effect of these policies.[56] Its cadet-procurement goals for 1943 already had been set.* Quotas were now established for the various arms, and it became necessary for the AAF to draw its aviation cadets from the over-all manpower quota allotted to the AAF each month. Under the quota system the AAF was to receive a total of 9,000 aircrew trainees in February, 44,000 in March, and thereafter it was to receive 18,702 monthly to meet the increased training goals planned for the summer of 1943. By 1 April it had become apparent that these monthly procurement quotas were not being met, and two months later the AAF was facing an accumulated deficit of 40,317 aviation cadets considered necessary to meet the current training program. Means to promote the flow of recruits into aircrew training from both civilian and military sources had to be found.

The ACER provided a cushion of over 90,000 men at the end of 1942, and one effect of the new developments with reference to man-

* As early as 12 October 1942 the Flying Training Command had been directed to increase pilot production to an annual rate of 102,000 by 31 December 1944 and to train annually a total of 12,000 bombardiers and 19,000 navigators. Subsequently, the pilot-training goal was lowered on 10 April 1943 to a figure of 80,000 annually but once again raised that summer to 93,600.

power was a decision in January 1943 to call up these recruits for a college program that was viewed as a preliminary to an early assignment to training.* Simultaneously, it was decided to offset the lowering of the draft age to eighteen by extending the ACER program to permit the recruitment of seventeen-year-old youths.[57] Orders to report for active duty, according to the plan, would be issued to such reservists within six months after their eighteenth birthday. The proposal was approved and became effective on 16 January 1943.

It was not long, however, before the War Manpower Commission stepped in and challenged the necessity to recruit seventeen-year-old youth for the ACER. The commission stated on 7 May 1943 that it disapproved of the policy and that recruitment of such youth should not be allowed in any area. General Arnold took issue with this ruling in a letter to Paul V. McNutt, chairman of the commission. Arnold reminded McNutt that the aircrew training program was voluntary, that those accepted for enlistment had to meet high physical and mental standards, and that the sources for such recruits were limited. He also pointed out that the armed forces could supply only one-half of the required number of aviation cadets and that the quality of the men left in the eighteen-to-twenty-six age bracket was steadily decreasing. Both the caliber and the size of the pool of seventeen-year-olds were emphasized. The dispute was resolved by James F. Byrnes, Director of War Mobilization, who informed the Army and the Navy on 22 June 1943 that they might continue to enlist men under eighteen as aviation cadets.

Although the AAF had counted on obtaining a considerable number of applicants through the extension of the ACER program to the seventeen-year-old group, the results were disappointingly small. It had been estimated that of the some 90,000 men who reached that age each month, 10,000 could be expected to enroll for aviation cadet training. By the end of June 1943, however, the AAF had got not 60,000 as expected, but only 16,438. The reason for the miscalculation was not difficult to locate. The Navy was doing a better job of interesting the seventeen-year-olds; it had conducted a vigorous campaign to familiarize high school students with the advantages of its program and was able to offer enlistment in the Naval Reserve and an immediate assignment to its V-12 college program as apprentice seamen. When action was sought from Army authorities to correct

* See below, p. 562.

this situation, it was discovered that legislative restrictions contained in the National Defense Act, as amended on 14 May 1940, permitted the enlistment by the Army of men under eighteen years of age only if they were enlisted on an inactive status. Moreover, the War Department was opposed to asking Congress for authority to extend the pay and allowances and the government insurance provisions of the Aviation Cadet Act to encompass the seventeen-year-olds. Not until the fall of 1943, when the Civil Air Patrol became an auxiliary of the AAF, was a partial solution to this problem reached. Thereafter, such reservists as desired to avail themselves of the opportunity could take pre-training aviation courses given by the Civil Air Patrol.

Another source for aviation cadet procurement after the ending of voluntary enlistments was that of the voluntary induction of civilians.[58] Selective service procedures permitted a man to apply for voluntary induction into some branch of the service but gave no guarantee that the inductee would necessarily be assigned to the service of his choice. It was a gamble worth taking, however, since his chances were better than if he waited to be drafted. The method of obtaining men in this category was worked out by TAG during the month of February 1943. Registrants were informed by newspaper advertisements that they could apply for aviation cadet training at their local aviation cadet examining boards. If the applicant passed the mental screening test, the physical examination, and was qualified as an aviation cadet for training as a pilot, bombardier, or navigator, he was to be furnished with a letter to the commanding officer of the local armed forces induction station. The registrant then applied for voluntary induction at his local draft board and was ordered to report for induction in the same manner as any other volunteer.

Two features of this procurement policy soon needed adjustment. For one thing, it was discovered that most applicants who had passed the mental screening test were being referred to Army air bases for their physical examinations because by 1943 flight surgeons were in such short supply that many examining boards were without them. Applicants had to pay their own travel expense to reach an Army air base, and this was another instance where the Navy had a decided advantage in recruiting. The Navy had long paid not only the examination travel costs of candidates who were qualified for naval aviation training but food and lodging charges as well. A change in Army regulations removed this discrepancy on 3 April 1943, and thereafter

civilian applicants qualified for aircrew training could be transported at government expense to receive physical examinations. The other revision in the voluntary induction system reduced the interval between a candidate's qualification by an examining board and his induction for training. As originally planned by the War Department, a voluntary inductee was to be allowed a maximum of ninety days after being qualified before offering himself for induction. This did not prove satisfactory, and in the fall of 1943 the War Department agreed to reduce the length of time that an applicant had at his own disposal before induction to forty-five days. Agreement was also reached with selective service officials that they would encourage local boards to speed up their induction of qualified aviation cadet applicants.

During 1943 men recruited from the Army for aviation cadet training were an important supplement to the number recruited from civilian life through the ACER and by means of voluntary induction.[59] Aviation cadet training, of course, had always been open to men in the service provided that they met the qualifications for such training. But no unit commander relished the loss of the type of men who could qualify for aircrew appointment, and enforcement of instructions for their encouragement to apply proved difficult. Many of the enlisted men did not know how to determine eligibility for flying training nor how to apply for it. Even more hampering by 1943 was the fact that enlisted men who volunteered for flying training lost their dependency allowances and, in certain cases, suffered material reductions in pay. Thus in spite of the urgent need for more recruits from military sources, aviation cadet training had become progressively less attractive to large numbers of enlisted men. Corrective measures were taken in July 1943. Enlisted men thereafter could train in grade and remain eligible for dependency allowances while taking aircrew training.

In the spring of 1943 the Assistant Chief of Staff, G-1, proposed that applicants for flying training be assigned to the AAF directly from Army reception centers. This proposal had merit; it would minimize one of the major causes of tension between the AAF and other branches of the service. There was no denying the fact that many units had suffered severe losses through the assignment to aviation cadet training of their trained and qualified enlisted personnel. The logic of the recommendation was compelling and the proposal received early approval. On 15 May 1943 TAG was directed to outline

the new policy to the commanding generals of the service commands. Instructions were issued in June making the reception centers a source for aviation cadets.[60] After 1 August 1943 those men processed at reception centers who expressed a desire to fly and who met the established requirements were to be assigned to AAF basic training centers as part of the quotas allotted to aviation cadet training. To be eligible, a recruit had to be a native-born American, score 100 or better on the Army general classification test, and meet necessary physical qualifications. All men who were accepted were warned that the selection was only tentative; that before being sent into aircrew training, it would be necessary to pass further physical, mental, and psychological tests; and that assignment also depended upon vacancies under existing quotas.

A "joker" in this plan became evident shortly after the new procedure went into effect. Because there was no provision at the reception centers to screen these volunteers to determine their qualifications for aircrew training, the basic training centers were finding that 65 per cent of the men received from this source could not qualify when put through the regular aviation cadet screening process. Meantime, all of these volunteers had been charged to the aviation cadet monthly quotas, with the result that procurement schedules of fully qualified men to fill training commitments were not being met. A solution to this difficulty, suggested by Brig. Gen. R. B. Reynolds of the Military Personnel Division of Army Service Forces and concurred in by G-1 and G-3 of the War Department General Staff, was issued on 6 October 1943 in the form of a directive from TAG to the commanding generals of all service commands. The directive stated that effective on 15 October 1943 Army reception centers were to administer the aviation cadet qualifying examination to all enlisted men who otherwise qualified; who volunteered for flying training; who made a standard score of 100 or better on either the Army general classification test or the mechanical aptitude test; and who, after a thorough physical examination by a representative of the Air Surgeon, appeared physically qualified for flight training as aviation cadets. Two days before the effective date of the directive, revised instructions were issued ordering each service command to establish special aviation cadet examining boards at the reception centers. This action brought procurement at the reception centers into line with recruitment procedures used to enroll aviation cadets from other sources. The existence of special examining boards at reception cen-

ters assured the AAF basic training centers that the qualifications of volunteers for flying training would be on a par with the qualifications of applicants received from other sources of supply.

By October 1943 the procurement crisis of the preceding six months had subsided. The flow of qualified candidates for aircrew training now exceeded the requirements under existing training directives and the AAF had a long waiting list. Since reductions in the annual pilot-training objective were contemplated, procurement officials were confronted with a situation completely the reverse of that which they had experienced earlier. Their problem was no longer one of stimulating the flow of recruits; their job was now to curb the flow in order to forestall the growth of an unwieldy backlog. As a first step to curb the flow, it was decided on 18 November 1943 to cut back the number of men procured for aviation cadet training so as not to exceed the annual training rate during 1944 of approximately 50,000 or 60,000 pilots a year. Such a rate would permit a reduction in procurement after 1 January 1944 to a figure of about 10,000 to 12,000 per month. The existence of the backlog, however, necessitated tightening the physical and mental qualifications for flying training. The passing mark on the aviation cadet qualifying examination was raised, the change to be effective on 10 February 1944; and in December it was decided that after 1 March 1944 only those candidates were to be accepted who met the physical standards as they had existed before August 1943. These changes, it was expected, would help adjust the supply to the demand. One group affected by the cutback was the officer corps. Because of the oversupply of aircrew candidates, drastic limitations were placed on the number of officers assigned monthly to take aircrew training in grade, a category that would have a backlog of 5,500 by 1 December 1943 and of 9,000 by 1 January 1944. On 30 November 1943 action was initiated to reduce the monthly quotas to 200 by March 1944. It was directed that officers training in grade be required to take the aviation cadet qualifying examination, and the passing score on this test was to be adjusted to secure the desired reduction in numbers.[61]

Early in January 1944 the Requirements and Resources Branch of the Military Personnel Division reported that the backlog of potential aircrew trainees was great enough to permit suspension of procurement until December 1944. On 22 February 1944 TAG accordingly directed all service commands to suspend procurement of aviation cadets from the Army Ground and Service Forces and to disallow

any further applications from officers and enlisted men for transfer to the AAF for aircrew training; the following week this latter ruling was extended to include AAF personnel. Late in March 1944 recruiting of draft-age civilians (voluntary inductees) was stopped and even enrollment of seventeen-year-old Air Corps enlisted reservists was temporarily halted.[62] The severity of these cutbacks may be gauged by comparing the total number of men tested at all psychological examining units during March (30,914) with those in April (16,511) and in May (9,369).[63]

In April 1944 General Arnold approved a plan to reduce the rate of pilot training to 40,000 a year, the cutback to be made in four stages, the final one coming with the class entering primary on 7 August 1944. The Training Command reassessed its pilot-training school needs at thirty primary, seventeen basic, eight advanced single-engine, and twelve advanced twin-engine schools. In September 1944 it was decided to extend by five weeks the training period of all students in individual pilot-training courses, effective 16 October 1944, while cutting the number of pilots trained to 20,000 a year. Despite a resumption of preflight enrollment on 30 November 1944, it soon became evident that the AAF had enough potential pilot graduates to finish the European phase of the war and supply the needs of the AAF in the Pacific until well into 1946. Consequently, the Training Command proposed in January 1945 that the backlog of accepted candidates be dissipated before resuming, on 15 November 1945, the flow of new aircrew trainees at a rate of 12,600 per month. Headquarters, AAF accepted this plan but it was never implemented. After V-E Day pilot production was ordered reduced to 1,000 per year or 100 per class, effective 30 June 1945 with the entry of class 46-A into primary.[64]

As compared with the pilot-training program, the programs for navigators and bombardiers had lagged, the former reaching its peak of 25,600 per year in August 1944, the latter a peak of 18,500 that September. Reductions were now aimed at stabilizing the bombardier program at 9,100 annually by April 1945, and the navigator program at 11,000 annually. In addition, the course of instruction was to be lengthened for both specialties, and provision was to be made for retraining experienced personnel. These actions reduced the opportunities open to preflight graduates. Then, on 19 February 1945, the entrance rate of the navigation schools was cut from 280 weekly to 70.[65]

The Negro

Although War Department policy from the beginning of the Army's expansion in 1939 required that all arms and services receive Negro troops in numbers proportionate to the percentage of Negroes among the total manpower of military age,[66] the Army Air Forces at no time included such a proportion. Based, in effect, on the percentage of Negroes among draft registrants, the proper proportion had been set in October 1940 at 10.6 per cent.[67] But the largest number of Negroes serving with the AAF at any one time was the 145,327, or 6.1 per cent, listed for November 1943, when the total strength of the AAF stood at 2,383,370. No official figures are available before August 1942, at which time 27,154, or only 2.8 per cent, of the total of 986,338 officers and men in the AAF were Negroes. In the closing month of the war there were 139,559, or 6.2 per cent, Negroes in the AAF—its total strength was then 2,253,182.[68]

Army general classification test scores limited the number of Negroes who could qualify for AAF technical and flying schools. From June 1941 to February 1942, 77.8 per cent of the colored inductees into the Army were in AGCT groups IV and V,* as compared with 29.1 per cent for the whites; in the latter half of 1943 the percentages were 79.4 for the Negro inductees and 24.7 for the others. In the AAF 79.1 per cent of Negro airmen scored in groups IV and V in contrast to 14.6 per cent for the others.[69] Like the rest of the Army, the AAF followed a policy of employing Negroes in segregated units, commanded "wherever possible" by Negro officers. This policy, while affording opportunities for the promotion of a few Negro personnel to command responsibilities, tended also to restrict the assignments of all Negroes, regardless of their educational qualifications, because the general level of competence naturally influenced the disposition of Negro troops, and it was contrary to policy to place Negro officers over white troops. In August 1942 the some 27,000 Negroes in the AAF included a mere 78 commissioned officers; in November 1943 there were 1,280 officers among the total of 145,000 Negroes; in August 1945, of the 139,000 Negroes, 1,533 had commissions.[70] As these figures indicate, it had not always been considered necessary to place Negro troops under Negro officers.

A very small percentage of Negro airmen received flying training.

* These two groups, in order, included those scoring 60–89 and 59 or lower. The highest possible score was 163. OCS candidates had to score at least 110.

Pilot training for Negroes was begun in November 1941 at the Tuskegee Army Air Field in Alabama, where the 99th Fighter Squadron was trained prior to its commitment in 1943 to MTO, there to be assigned in 1944 to the 332d Fighter Group commanded by Col. Benjamin O. Davis, Jr. The 477th Bombardment Group (M), activated on 15 January 1944 and subsequently reorganized as a composite group under Colonel Davis' command, had not been committed to combat when the war ended.[71] The peak figure for Negro troops deployed by the AAF overseas was 74,273 in the month of July 1945, of which number 347 were commissioned officers; at that time, the total of Negroes stationed within the United States was 67,126. Not until May 1945 did the total of Negroes overseas exceed the number stationed at home. Over-all figures for AAF deployment show a larger percentage of the total force overseas by January 1945.[72]

Whether at home or overseas, most Negroes were assigned to some kind of supporting or service unit, and many of them were carried as ASWAAF's. They were to be found in such units as quartermaster truck companies, chemical depot companies, air cargo resupply squadrons, and aviation squadrons, which might as well have been designated as labor battalions, for they were largely concerned with the physical effort required for the upkeep and maintenance of air bases.[73] Only two all-Negro service groups were organized during the war: the 96th and the 387th. The first of these experienced many difficulties of training and leadership before its commitment to overseas service in 1944 under white officers. The second, whose ranking officers were white from the beginning, included so many airmen with high AGCT scores as to suggest that educational qualifications counted more than any other single factor in the quality of unit achievement.[74]

The Personnel Distribution Command

Because AAF units were among the first to be committed to battle, their personnel quickly became experienced combat veterans, and when their services could be spared, some were rotated home for assignments in training and other capacities. Later, as the air war accelerated, various theaters adopted rotation policies by which combat personnel became eligible for return to the United States, policies usually based on a more or less specifically defined number of combat missions. By the spring of 1943 it was anticipated that approximately

5,000 veterans per month would be returning by that August, and the number thereafter would increase rapidly. Returnees had been assigned directly to appropriate Zone of Interior commands, but they had not been screened to determine the disposition of hospitalized, fatigued, or incompetent men. On 7 August 1943 the AAF Redistribution Center was established as an exempted activity under AC/AS, Personnel for this purpose. This agency was redesignated on 1 June 1944 as the AAF Personnel Distribution Command (PDC) and was given broader functions.[75]

Three redistribution stations were established—Atlantic City, New Jersey; Miami Beach, Florida; and Santa Monica, California—where resort hotels and beaches offered facilities for recreation. Later, three additional redistribution stations were activated—at Greensboro, North Carolina; at Santa Ana Army Air Base, Santa Ana, California; and at San Antonio Aviation Cadet Center, San Antonio, Texas, where facilities of Training Command installations had become surplus by 1944.[76]

The three original redistribution stations worked out a schedule for receiving and processing returnees. The returnee was first given an orientation lecture and was then put through a unit personnel check, with particular attention to pay problems, legal affairs, and allotments. This was followed by a thorough physical examination and a careful check for emotional stability which included interviews and, where necessary, hospitalization and psychiatric study. After a re-examination of the returnee's record, he was classified for future assignment. The original processing schedule of a week for the normal case was later shortened to five days. Thereafter, the returnee was free to engage in recreational activities or his personal affairs.[77]

With the increased flow of returnees in 1944 some refinements in this routine were made. Beginning in October 1944 the Training Command sent liaison units to assist with assignment problems. In November psychological research units were established at redistribution stations to administer tests for the more efficient reassignment of personnel. By the end of the war, plans for even more elaborate testing and research projects had been developed.[78] After 15 February 1945 some 95 per cent of returnee aircrew personnel and a substantial proportion of ground crew members were being assigned to the Training Command.[79]

Special policies had to be established for those combat returnees who needed rehabilitation because of physical or emotional diffi-

culties. These persons, after a twenty-one-day leave, returned to the redistribution stations for a more leisurely process of reassignment. An effort was made to dispense with the traditional atmosphere of a normal military post by placing great stress on a full schedule of various types of entertainment and recreation.[80]

Special treatment was accorded all former prisoners of war, escapees, evaders, and internees, and separate projects were set up for the various groups. Officers below the grade of colonel and enlisted men below the grade of master sergeant were promoted one grade above that held at the time of surrender, and they were given a ninety-day period of temporary duty for rehabilitation, recuperation, and recovery. Thereafter, they were given a choice of available assignments, with preliminary training if necessary.[81] During 1945 the hotel-type stations began to assume the status of convalescent homes, with an ever-increasing number of occupants.

However, on 12 June this leisurely type of processing was ordered discontinued because impending demobilization policies demanded the use of the stations and medical officers for the separation program. By August facilities at redistribution stations were still being used chiefly for repatriated personnel, but with an emphasis now on the personal affairs sections of the processing machinery. Personal affairs experts worked closely with the various federal employment agencies and with the Veterans Administration to make the return to civilian life smoother.[82]

CHAPTER 16

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BASIC MILITARY TRAINING AND CLASSIFICATION OF PERSONNEL

THE United States has traditionally fought its wars with a citizen army mobilized and trained after the emergency arises. Its members on their induction into the Army face an abrupt transition to a life and pattern of behavior altogether foreign to their previous experience. For their assistance the Army has provided an initial period of basic military training, a course of instruction intended to transform the raw recruit into a soldier. This basic training includes instruction in military discipline and courtesy, close order drill, first aid and protection against disease, physical conditioning, defense against enemy attack, and the care and use of weapons. Only after completion of basic training are recruits, in theory, advanced to instruction in the technical specialties of the particular Army arm or service to which they are assigned. In practice, however, it has not always been possible to follow the theory. Both in World War I and during the first year and a half of World War II, certain phases of basic training were sometimes slighted in order to speed the training in specialties for which a critical need existed.

Such acceleration was particularly true of the air arm. In theory, each man entering the Army received the same basic training, but the responsibility for such training was assigned to the several arms and services, and in the air arm much of that training, traditionally geared to the needs of the infantryman, had little bearing on the functions to be performed by its men. During the First World War, the Aviation Section had stressed technical instruction at the expense of military training in its two mechanics schools—at St. Paul, Minnesota, and at Kelly Field. Even after the war the Air Service had directed in 1921

that its personnel should receive only that portion of the training normally given the infantry which would permit them to move in a military manner from place to place. War Department directives, however, continued to assume that all recruits would be required to meet minimum standards in such subjects as close order drill and the handling of individual weapons, and mobilization plans of the 1930's had assumed that basic training would be provided for all in training centers to be established in the several corps areas, with the recruits to be assigned to the several arms and services only after they had attained the required proficiency in a common training program. But the pattern which developed after 1939 was quite different from that planned.

As the number of recruits increased, it was decided in the summer of 1940 to establish a replacement training center for the Air Corps at Jefferson Barracks, St. Louis, Missouri, an old Army installation made available for the purpose. To relieve the combat units and the technical schools of obligations for the training of the raw recruit, Jefferson Barracks was charged with the responsibility for basic military training and for classification tests that would govern his subsequent assignment. By the fall of 1941 additional centers had to be activated at Keesler Field, Mississippi, and Sheppard Field, Texas, to care for the increasing flow of recruits. Since the road ahead for most AAF enlistees led toward some specialized technical training, the replacement centers were placed under the jurisdiction of the Air Corps Technical Training Command, an arrangement thoroughly consistent with the long-standing tendency in the Army's air arm to subordinate military to technical training.

Basic Training

The original staff for the Jefferson Barracks replacement training center was composed of a cadre of officers and enlisted men supplied by Scott Field. The Keesler and Sheppard Field replacement training centers were in turn staffed by cadres from Jefferson Barracks. At the time of Pearl Harbor the Air Corps had some 21,000 recruits at its three centers.[1]

With the coming of war, the pressure on existing facilities and staffs outpaced all efforts to keep up with the need. For more than a year Jefferson Barracks was forced to use a large number of tents, and the same situation prevailed at Keesler Field. Construction of new

barracks never seemed to keep pace with the flow of recruits, and early in 1942 the AAF began to use resort hotels at Miami Beach and St. Petersburg in Florida and at Atlantic City in New Jersey. Most of these structures proved to be suitable enough for troop quarters once the rooms were stripped of amenities furnished for the convenience of civilian vacationists. Room capacity was raised to four or five by use of double-deck beds. The increases in the number of occupants, however, exceeded the limit for which the buildings were designed, and it was difficult to keep water pressure adequate, especially in the evening, when there was a rush to remove the grime of the drill field before standing retreat. Moreover, the congestion made it difficult to evacuate the large hotels even when the men expected to be called, and hence fire drills were held frequently. Nevertheless, use of these luxury-type quarters materially eased the basic training center (BTC) housing problems when the need was greatest. By the spring of 1943 the number of basic training centers, as the replacement training centers had been redesignated on 7 August 1942, had been increased by seven.*

In this as in other phases of the training program, the peak load was reached and passed in 1943. Thereafter, some centers were inactivated, and others were moved to posts where technical schools had been located. Four basic training centers survived until 4 September 1945—Buckley Field, Amarillo Army Air Field, Sheppard Field, and Keesler Field, with most of the trainees located at the two latter stations.

Prior to July 1943 basic military training apparently was the orphan of the vast AAF training organization. BTC's were at the end of a long chain of command, they were given only rough outlines to go by, and responsibility for the program was in effect left to local authorities. Initially, the program was based mainly on the experiences of the pioneer BTC—Jefferson Barracks—which served as a testing ground for administrative organization and training policies. There, in the absence of clear-cut directives, the commanding officer and his staff had exercised their functions with comparative freedom. Three school squadrons constituted the administrative units for handling trainees at Jefferson Barracks in the fall of 1940. In theory the first

* Additional basic training centers were established at Kearns, Utah; Lincoln, Neb.; Fresno, Calif.; Buckley Field, Colo.; Greensboro, N.C.; Gulfport Field, Miss.; and Amarillo, Tex. A provisional center was also established at Seymour-Johnson Field, N.C., during the summer of 1943.

squadron received, clothed, and processed the men; the second gave them a three-week training course; and the third arranged for their dispersal to other stations. Because of the newness of the task and the large daily influx of recruits, efforts tended to be concentrated on problems of housing, clothing, and equipping the men, and training was neglected. In the spring of 1941, school squadrons became training squadrons, each of which assumed responsibility for processing, training, and shipping its own men.

After Keesler and Sheppard Fields began to function in the summer of 1941, the Technical Training Command sought to provide more effective supervision for the work of the training squadrons by establishing provisional school groups, with a group supervisor to coordinate the activities of the squadrons assigned to his organization. This officer had the status of an assistant post executive but was without command functions. Later, during the winter of 1942–43, training wings replaced the provisional school groups, and the groups took over the training function. Upon arrival at a BTC, recruits reported to a training group for assignment to one of its flights. For instructional purposes a flight was regarded as a class, and its members went through all phases of the training program together.

The first training schedule, issued at Jefferson Barracks in October 1940, covered a four-week period, with time allocated as follows:

Subjects	*Hours*
Military courtesy	6
Articles of War	4
Personal hygiene and first aid	12
Wearing of uniform	8
Alpha and mathematics test	2
School of the Soldier	127
Interior guard duty	6
Government insurance	3
Miscellaneous	24
TOTAL	192

A breakdown of School of the Soldier gave principal emphasis to physical training, squad drill, platoon drill, company drill, marching and ceremonies, and field marches. Two observations are pertinent—the emphasis on Infantry subjects and the absence of weapons training. Subsequent programs at Jefferson Barracks and at Keesler and Sheppard Fields followed this schedule in most respects, with modifications to meet local conditions.

The BTC's, handicapped by the absence of training directives and by shortages in personnel, equipment, and facilities, failed to attain desired standards of proficiency until more than a year after Pearl Harbor. Orders to fill technical school quotas even though recruits so shipped had not completed the training program also served to compound the difficulties. The length of the basic training program for most recruits remained fixed at four weeks, although there had been a general complaint that it was impossible to give more than superficial instruction in so short a period. The only exceptions to this rule applied to personnel from Arms and Services with the AAF (ASWAAF) and to enlisted men who were not to be assigned to technical schools; by directive from Headquarters, AAF the basic training program for these two categories was to be extended to eight weeks. Otherwise, the necessity for rigid compliance with the directive to keep the technical school quotas filled continued to be emphasized, a policy which its proponents justified by the hope that time could be found in the technical schools to make up at least part of the resulting deficiencies in basic training. Hence, for thousands of recruits during 1942 basic training centers were primarily reception centers where they were processed, given only the most superficial kind of training, and then shipped off to technical schools.

Changes in the basic training program began in 1943, and by 1944 a marked improvement was noticeable. Reports from overseas commanders pointed out that men reaching their theaters lacked training essential for survival, particularly in marksmanship, marching, and bivouac. With the training program approaching full tide and the demand for shortcuts to fill quotas lessened, it became possible on 1 May 1943 to lengthen the basic training period to eight weeks for all recruits, a period sufficiently long to allow more time for subjects already in the curriculum or the addition of new ones. In addition, the accumulated experiences of those in charge of basic training led to the adoption of improvements that enriched the program.

Although higher headquarters had long been aware of the deficiencies in basic training, it was not until June 1943 that Headquarters, AAF undertook to establish minimum requirements for training of personnel before their assignment overseas. Starting in July 1943 an attempt was also made to set up a standardized program for the eight-week basic training program in effect at the BTC's. Emphasis was placed on subjects with a practical application to survival in the com-

bat areas—camouflage, chemical warfare, map reading, marching and bivouac, and marksmanship. A memorandum issued by the AAF Training Command in December 1943 prescribed an eight-week schedule of instruction for regular trainees and a five-week schedule for pre-aviation cadets. Only two revisions of this memorandum had appeared by the end of 1944, although supplementary memoranda on specific subjects in the schedules were issued from time to time.*

The initial processing period at a BTC lasted from four to six days. It was essentially an orientation period. Orientation talks given by commanding officers and other commissioned personnel afforded an excellent opportunity to ease the minds of men whose reception center experience had been disturbing. The value of such talks depended entirely upon the officer's interest, personality, and effectiveness as a speaker. Other processing lectures on military courtesy, Articles of War, sex hygiene, war bonds, and life insurance were, except for the one on sex hygiene, given by enlisted men. Films were used whenever applicable. Processing also included blood-typing, immunization, a "showdown" inspection of clothing and equipment, elementary drill instruction, and tests and interviews at the classification section.†

Earlier failures to provide adequate training in marksmanship were attributable to more than the haste to get men on to the technical

* The last revision prescribed subjects and minimum hours as follows:

Subjects	*Hours*
Articles of War	2
Organization of the Army	1
Military discipline, customs, and courtesies	3
Medical aid (including 8 hours of military sanitation and sex hygiene, 8 hours of first aid, 4 hours of malaria control, and 3 hours of personal adjustment)	23
Close order drill	14
Camouflage and individual security (including scouting and patroling and defense against air attack)	9
Interior guard duty	2
Care of clothing and equipment; and tent-pitching	5
Safeguarding military information	1
Defense against chemical attack	6
Marksmanship and small-arms firing	54
Elementary map and aerial photograph reading	4
Army orientation course	5
Physical training	15
Night operations	4
Marches and bivouacs	24
TOTAL	172

† See below, pp. 542–44.

schools and the often overwhelming burden of the administrative load. Possessed of the lowest priority rating of any training unit in the Army, the BTC's lacked arms and ammunition; most of them had no firing ranges, and engineering difficulties slowed construction of such facilities as were made available; and they were woefully short on officers and enlisted men qualified to give marksmanship instruction. Reports streamed into Washington from overseas, from the continental air forces, and from air inspectors that troops had little or no training in the use of small arms; and on 31 December 1942 the Deputy Chief of Staff of the Army, Lt. Gen. Joseph T. McNarney, commented on the situation in a memorandum to the Chief of the Air Staff:

> I note that practically without exception all service units being shipped overseas have fired only a familiarization course with the weapon with which they are armed. As I understand it, this familiarization course consists of only twenty rounds. It seems to me that an individual who has fired only twenty rounds would be more dangerous to himself and his fellow-soldiers than to the enemy.[2]

In January 1943 the War Department responded by directing that no soldier, with the exception of certain normally unarmed technical specialists, would be transferred for movement overseas until he had fired the course prescribed for the weapon which he was issued—a directive that seems to have been aimed at correcting Army-wide, not merely AAF, training deficiencies.

It took time to give full effect to this directive, but by July 1943 schedules prescribed by AAF Headquarters stipulated an allotment of ninety-nine hours to marksmanship. Meanwhile, the burden of catching up on arrears fell heavily upon the technical schools, which were feverishly active during the latter part of 1943 providing the necessary ranges, weapons, ammunition, and instructors. The technical schools were relieved of most of this responsibility after mid-1944, by which time practically no recruits left BTC's without having fulfilled all training standards for firing. By that time, too, the Training Command had discovered that a fifty-four-hour course at BTC was sufficient to assure the necessary proficiency.

In contrast with the difficulties experienced in marksmanship, the physical fitness program at the BTC's was highly successful from the very first. Physical conditioning for trainees started immediately upon arrival and continued systematically and progressively until they left. The program was designed to develop strength, coordination, agility, and skill; it included both calisthenics and athletic games that de-

veloped confidence and spirit. To an increasing extent, emphasis was placed on exercises which would have the greatest military significance —the obstacle course and hand-to-hand fighting. Individual physical fitness tests were inaugurated in 1942 to measure the progress made by recruits at intervals during the training period. Such tests spurred men on to greater effort. Research on cumulative physical fitness scores likewise enabled the training specialists to revise and enrich their programs. Doubtless many trainees considered the program too strenuous, but the policy implicit in training directives was that to achieve results men should "give until it hurts."

Training in chemical warfare defense, although a part of the basic military training program from its inception, received little emphasis until 1943 when chemical warfare officers assumed charge of this instruction. From then on, recognition of the importance of the subject gradually replaced the lack of interest previously so evident among AAF officers. More equipment was made available, the course of instruction was lengthened, and its content varied. Instruction by lectures and films was supplemented by practical training in the use and importance of the gas mask, a phase of instruction carried on in specially constructed gas chambers. Gas-alert days were scheduled during which all personnel were required to carry their masks, since any part of a post area might be sprayed at any time. Extensive use was also made of training aids in the form of charts, posters, cartoons, and displays of equipment and protective clothing. An important part of the course included demonstrations of chemical agents such as incendiaries and smokes and of methods of combating them.

As lessons from combat theaters found their way into the training program, more attention was paid to camouflage, individual security, defense against air attack, scouting and patrolling, and recognition of American aircraft—subjects combined in 1944 into a nine-hour course. The importance of such subjects was reinforced by more time being given to bivouacs and marches. Living in the open under simulated field conditions, trainees were physically hardened, learned how to protect themselves from disease and the elements, and withal got realistic practice which supplemented the lectures, films, and demonstrations of their classroom instruction.

The task of orienting trainees in the ideology of the war was greatly aided when the armed services, in cooperation with the motion picture industry, began to issue feature-length war orientation films. Such films as "Prelude to War," "The Nazis Strike," "Divide and

Conquer," and "Battle of Britain" were calculated to impress upon the men the threat to their cherished way of life. After mid-1943 basic training programs also allotted from five to eight hours to what was called an Army orientation course. The objectives were to provide factual information on the causes of the war; to discuss the war aims of the United Nations and the personal role and responsibility of the individual in total war; and by means of a wide variety of films and news maps, supplemented by lectures, to afford recruits a chance to follow the progress of the conflict. The course was well calculated to enlist the interest and enthusiasm of the personnel for whom it was intended.

All phases of basic training suffered from a shortage of qualified officer personnel, but nowhere was it so marked as on the drill field and in the classrooms. Many factors accentuated the problem. There was a great demand in 1942 for the services of competent men, especially for cadres to staff new installations, and this rapid turnover spread the experienced men very thin. Many officers, commissioned directly from civilian life, lacked military experience and were singularly unfitted for Army duties, particularly instructional ones. Malassignments were frequent, and capable instructors were as likely as not to be kept at administrative jobs in which their talents were lost in a maze of paper work, while officers with little interest in training activities received teaching assignments. Even more serious, when promotions were made, administrative officers were more likely to receive them. This hurt the morale of the instructional staff, and at times an assignment to the drill field was looked upon as a kind of exile for men unable to perform administrative duties.

From time to time schools for the correction of officers' teaching deficiencies were set up in the BTC's. The one held at Jefferson Barracks late in 1943 was significant because the course, material for which was derived from the training program then in use there, placed emphasis on teaching methods. Students were required to achieve a high level of proficiency, and their subsequent assignments at this post were exclusively in the instructional field. Schools like this one paid off by raising the level of recruit training. A similar course was revived in August 1945 when some 200 rated officers were assigned to BTC's to assist in the training program. Before assuming duties as instructors, they were given a short course at the station level in order to qualify them for these duties.[3]

The shortage of assigned enlisted men at BTC's was as serious as

that of officers. There was a continual drain on the permanent party for staffing cadres and to permit qualified men to attend OCS and to go into the aviation cadet program or to technical schools. Overseas combat duty eventually claimed most physically qualified men. As a result, there was a constant search for replacements among limited service men.

It was universally accepted that drill instructors made up the most important group among permanent party enlisted men. A drill instructor was first and foremost a teacher, but even aside from the formal instruction they gave, these men had it in their power to influence in marked degree the manner in which recruits accepted Army life. Many men who held this job, unfortunately, were unfit for it by training, inclination, and personality. To fill the ranks of drill instructors BTC's found it convenient to choose recruits who had just completed their basic training and give them a course in a drill instructor school. When graduates were too few, a not uncommon situation, resort to other measures was necessary, and outstanding trainees, men who had some previous military service, and eliminated aviation cadets were put to work on the drill field while awaiting other assignments. Even pre-aircrew trainees who desired drill instructor assignments pending entry into preflight training were utilized in the fall of 1944, and in the summer of 1945 some 600 aviation cadets who had just graduated from preflight served as drill instructors while in an on-the-line status* at Keesler and Sheppard Fields.

Perhaps the most perplexing problem faced by the basic training centers in the last two years of the war was that of maintaining morale. As the trainee population became more diversified after 1942, morale problems peculiar to each new type of trainee developed. ASWAAF's, who belonged to organizations not integral to the Air Corps, felt that they were being discriminated against. Pre-aviation cadets were apprehensive about possible elimination or delay in getting into the aircrew training program. Eliminated aviation cadets, sent to BTC's from college training detachments and preflight and flying schools, found it difficult to make the adjustment to their lowered status. Those men who had been transferred from the Army Ground and Army Service Forces for aircrew training and then declared ineligible early in 1944 because of the curtailment of that pro-

* See below, pp. 564–66.

gram were particularly dissatisfied. Another disgruntled group consisted of the trainees and instructors formerly in the War Service Training program who had been sent to BTC's for reclassification and reassignment after discontinuance of that program late in 1943. The most serious morale problem, however, arose from the presence of combat returnees who began to arrive in large numbers after mid-1943. Following processing, these men were compelled to make up any deficiencies found in their basic training records. It was often necessary for them to study subjects which they understood thoroughly as a result of their combat experience.

Evaluation of the AAF's basic military training program during World War II requires that praise and blame be distributed in about equal proportions. Much that was poorly done must be attributed to the lack of experienced personnel qualified to administer such a vast program, to the haste that was attendant upon the establishment of the facilities for the training, and to the fact that responsible training officials were so intent on filling the quotas for special training that until mid-1943 they overlooked obvious defects in basic military training.

General Classification Procedures

A system of classification of enlisted men, such as the Army later adopted for all personnel who were inducted into its various arms and services, had gradually been developed in the air arm in the interval between the two world wars. By the late 1930's many of the jobs performed by Air Corps enlisted men had become so technical that trade-test centers for screening all recruits by test and interview were established at major Air Corps stations. These centers had World War I antecedents, trade-test boards having been used then to select qualified recruits for specialized training at the two air technical schools. After the war similar boards continued to operate at Chanute Field, under the supervision of a trade-test division. There, by 1939, applicants for specialist training, whether obtained on assigned status from Air Corps stations or directly from civilian life, were being sifted by tests and then assigned to any one of a dozen courses which were given at Chanute Field and its affiliated schools.[4]

After the start of the expansion program in 1939, trade testing was decentralized and a number of major installations—including Langley,

Mitchel, Barksdale, March, Hamilton, and Moffett Fields—were designated as recruit reception posts. All enlistees were tested during the recruit training and indoctrination period to determine their eligibility for assignment to meet the enlarged technical training goals. Recruits who qualified were earmarked for assignment to technical schools; those unqualified were slated for apprentice training which might later permit them to qualify for specialist training. All testing was supervised by the trade-test division at Chanute Field which acted as a clearinghouse to insure standardized administration of the examinations. By the fall of 1940 about two dozen trade-test centers were in operation. They supervised the filling out of information cards, administered and graded tests, interviewed each trainee regarding choice of school, and obtained a transcript of each enlisted man's high school record. Tests included the Army's revised Alpha mental alertness test, a shop mathematics test, and standard oral and pictorial trade tests. After the recruit's general aptitude for technical training had been established by the test, he was interviewed to determine the course to which he would be assigned. Admission to some courses, particularly those which were more advanced and complicated, was restricted to high-scoring candidates.[5]

Meantime, a parallel development was occurring in the Army, a move that would supplement and, at times, complicate the classification system of the air arm.[6] In 1940 the War Department, confronted with thousands of men brought into the Army through general mobilization and selective service, adopted an Army-wide classification system designed to insure the proper assignment of each individual. Under authority of Army Regulation 615-25, a network of reception and replacement training centers was established to process and screen recruits for suitable assignment to all arms and services. The reception centers were clearinghouses for the Army as a whole, while replacement training centers were arm or service installations designed to give additional screening to meet branch requirements.[7] The main task of the reception centers was to distribute recruits in such a way that all arms and services got a fair share of men in terms of quality as well as numbers. To this end, every recruit was classified by civilian experience, aptitude, and intelligence so that requisitions for each branch might be met with an appropriate distribution of men with the desired qualifications.[8]

A soldier's qualification card (WD AGO Form 20), which occupied a central place in the scheme of classifying and assigning enlisted men, was filled out partly at the reception center and more fully later at the BTC. This form, devised soon after the effective date of the Selective Service Act of 1940, was kept current throughout a soldier's career by the addition of pertinent information; it followed him wherever he went until he died in the service or was discharged, at which time the form was forwarded to The Adjutant General for permanent filing. When Form 20 was recorded and coded, all data necessary for a comprehensive picture of the soldier's abilities and background were always at hand; this form was intended to facilitate his successive placement in assignments well suited to his aptitude.

Army reception centers used a series of test batteries and interviews to ascertain the job experience and mental equipment of recruits. The standard battery included the Army general classification test (AGCT), a mechanical aptitude (MA) test, and a radio code aptitude test. The AGCT was introduced in the fall of 1940 to guide the Army in its training activities by identifying fast and slow learners. Test scores revealed the probable speed of learning and permitted recruits to be divided into five grades: Grade I (130 and above); Grade II (110 to 129); Grade III (90 to 109); Grade IV (60 to 89); Grade V (59 and below). The MA test was at first given only to those who scored above Grade V on the AGCT, but after March 1943, when the manpower pinch developed, it was given to all men except illiterates and non–English-speaking enlisted men. All men who scored eighty-five or above on the AGCT were given the test which indicated ability to master Morse code.[9]

An important phase of the classification of recruits was the interview which uncovered such civilian experiences as skills derived from employment or hobbies and the extent and type of schooling. The objective was to establish a relationship between civilian occupational experiences and a job specialty that would be most useful to the Army. The principal guide in ascertaining this relationship was AR 615-26, an index that defined and coded civilian occupations by specification serial numbers (SSN's) and tried to match them with Army counterparts called military occupational specialties (MOS's), which were also coded by SSN. Many civilian SSN's, such as cook, could be converted directly to military SSN's; other MOS's, such

as aircraft armorer, were distinctly military and required varying degrees of training.[10]

After the interview a classifier reviewed the recruit's papers and made a recommended assignment to an MOS within the arm or service that had a particular need for it. Army reception centers appear to have given more weight to occupational specialty than to aptitude and intelligence in making assignments, principally because they were guided by requirement and rate tables that indicated numbers and types of occupational specialties needed by each branch of the Army in rates per 1,000. The Adjutant General prepared the tables and revised them continuously to meet changing arms and services requirements. Each shipment of men from a reception center presumably contained the required percentages of occupational specialists but, when men with exact qualifications were not available, substitutions were made in related job specialties.[11]

The expansion of the Army after Pearl Harbor placed a staggering burden on the Army reception center classification system; within a year AAF enlisted personnel alone were to increase from approximately 330,000 to nearly 1,470,000, and by August 1942 a goal of 2,200,000 officers and men had been projected. Since all Army enlisted personnel would be channeled through the reception centers, the AAF faced a difficult problem. Assignments from these centers were based primarily on occupational specialties, and the majority of the specialties required by the AAF did not, in view of the relative newness of the aircraft industry, turn up in men secured through the draft. Moreover, the technicians needed in the AAF were to be put through a training course considerably more condensed than those of prewar years, and this speed-up presupposed trainees with intelligence superior to run-of-the-mine draftees. Air Corps experience with draftees in 1941 had demonstrated that almost half of those received had lacked the intelligence necessary for technical training, and the War Department was informed in January 1942 that unless this situation was corrected, the paramount mission of the Air Corps would be jeopardized. Consequently, the AAF sought and obtained a ruling that after 2 February 1942 at least 75 per cent of the reception center regular Air Corps allotment should contain men scoring 100 or better on the AGCT.[12]

With this ruling as a basic policy, the AAF next took steps to insure that it got all men from reception centers who had aviation experience and interest, and after March 1942 all recruits who had

previous training in aircraft factories, with airlines or in aeronautical schools, and as weather observers and weather forecasters were assigned to the AAF. By June 1942 draftees who had one month's or more experience in any phase of airline operation and those employed immediately prior to entry into the service in the manufacture of aircraft, aircraft engines, and other accessories, were likewise tagged for AAF assignments. Special measures had also been taken in March to retain in the service of the AAF those thousands of civilians employed in a civil service capacity as mechanics, technicians, and other specialists who were liable to draft calls and thus might be lost to other arms and services. It was proposed that such persons when drafted should report to the nearest reception center for processing and then return to their station of origin as part of the AAF monthly quotas. This recommendation was accepted by TAG and broadened several months later to cover personnel employed by all arms and services at AAF stations.[13]

By summer the Army Ground Forces and the Services of Supply had complained so vigorously about this preferential treatment of the AAF that the War Department decided to rescind the 75 per cent rule on 18 July 1942, and an allotment system of assignment was reinstituted. The return of this "grab-bag" system, as the AAF called it, caused General Arnold to appeal directly to the Chief of Staff for reinstatement of the former policy. On 29 August, Arnold told Marshall that the rapid and continued commitment of air units to combat, in accordance with over-all strategic plans, could only be accomplished by a great acceleration of training, and that the speed-up was feasible only if men of a high order of intelligence were assigned to the AAF. Ten days later the War Department put the AAF back in a favored position and ordered that during September and October (later extended through November) the monthly quotas for the AAF should include 50,000 men who scored 100 or better on both the AGCT and the MA tests. This new preferential policy turned out to be even better for the AAF than the old 75 per cent rule, since only about 33 per cent of the men tested scored 100 on both tests. As a consequence, the top third of the available manpower received at reception centers was assigned to the AAF during these three months. These high-scoring inductees constituted almost three-quarters of the new personnel received by the AAF from reception centers in this period.[14]

Later in November 1942 the AAF warded off another threat to

return to the "grab-bag" system, and General McNarney, deputy chief of staff, ruled that preferential assignment to the AAF would remain in effect until 30 June 1943. The ruling, made on 28 November, provided that 55 per cent of the men assigned by reception centers to the AAF should have scores of 100 or better on both the AGCT and the MA tests. This took the AAF past the peak of its enlisted personnel expansion program, a peak reached in May 1943; by that time, too, its technical training projects were "over the hump." The 55 per cent rule was voided on 1 June 1943, a month before it was scheduled to expire.[15]

Once an enlisted man reached an AAF basic training center, the process of classification continued until the type of training or duty to be given each recruit was determined. Recruits were first divided into three categories on the basis of an examination of Form 20's and a physical examination which determined physical classification (highly significant in 1943 when men with superior physical qualifications were needed in combat-crew training programs): "potential" specialists, non-specialists designated for technical training, and basics. Specialists included those with civilian or military training which fitted them for immediate assignment to a unit and those with an authenticated ability in a rare specialty needed by the AAF. Non-specialists were those whose AGCT and MA scores met the minimum acceptable standards for technical training. Basics were men who possessed no special abilities and had made low aptitude scores; they were assigned to units for immediate on-the-job training commensurate with their ability. About half of the AAF enlisted personnel during the period from 1939 to 1945 fell into the second category. For this group the round of testing and screening continued until they were assigned to a particular course of instruction. If quotas permitted and other requirements were met satisfactorily, trainees were encouraged to volunteer for the type of training they desired. Orientation lectures, generally slanted so as to encourage interest in courses with large personnel requirements and continuously revised as demands shifted from one program to another, outlined the types of training available (including aircrew, combat-crew, ground-crew, and ASWAAF schools) and the prerequisites for assignment. During 1942 the emphasis was placed on the advantages of ground-crew training as airplane mechanics, armorers, and radio operators; in 1943 combat-crew programs were stressed.[16]

Although the AAF had insisted that it must have men with a minimum score of 100 on both the AGCT and the MA tests for initial selection as trainees in most of its technical courses, it was forced to modify these entrance requirements in mid-1942 when preferential assignment to the AAF was temporarily discontinued. The first breach occurred when standards for gunnery training were lowered to admit men with a score of seventy-five on the AGCT and a score of eighty on the MA tests. Later, in the fall of 1942, a score of eighty-five on the AGCT would admit men to most basic courses, and in the winter of 1943 recruits with a score of eighty on the AGCT could take the radio code and mathematics tests. By May 1943 classification officers had been directed to use their own discretion in relaxing standards for selection of eligible men to be entered in technical training courses. Anticipating a rush of inductees with lower AGCT scores, classifiers were told to follow this criterion: "Will the recruit be of more value to the service after undergoing technical training, even though he may 'wash-back' one, two or three phases of technical training?"[17]

The classification of technical trainees was also affected for a period of about four months during 1943 by General Weaver's campaign to do away with conventional classroom teaching methods and substitute a system of practical demonstration and performance. All means of instruction dependent upon words—books, written examinations, lectures, and blackboard demonstrations—were eliminated from all courses except a few where language was essential. To bring classification into line with this policy, a battery of sixteen practical performance tests was adopted as a partial substitute for paper and pencil tests.[18] The experiment ran into all sorts of difficulties: in obtaining equipment and machinery, in servicing the test equipment, in standardizing and validating tests, and in administering the program in the BTC's. The resulting confusion called forth an investigation by The Adjutant General's office, and when the Flying and Technical Training Commands were consolidated in July 1943, the Training Command junked all but two of the performance aptitude tests and a large number of paper and pencil tests. After 15 September 1943 the following battery was used throughout the remainder of the war: weather-aptitude test, cryptography-aptitude test, general technical test, and trade information test. Minimum AGCT scores for basic courses were established at eighty-

five, and classifiers were told to consider carefully past skills and hobbies as well as test scores in selecting eligibles for training.[19]

After classification had been accomplished at basic training centers, the next step was assignment to a training program. At this stage, particularly during the first year and a half of the war when changes in programs, allotments, and school quotas were sudden and unexpected, whole groups of trainees classified and tentatively ticketed for one assignment might be reassigned for entry into a training program that had been given a higher priority.[20] The fault was not at the BTC's but at higher headquarters where school quotas were "prepared in many cases without regard for the number of enlisted men of the desired categories actually on hand." Under these circumstances, assignment officials had no choice; keeping quotas filled was paramount and "outweighed abilities and aptitude in the matter of assignment. Thus inevitably the careful work of the classification sections frequently came to naught."[21]

Better coordination was achieved after July 1943 and was brought about by two factors. In the first place, the training of technicians had reached a stage where the programs could begin to taper off, and more emphasis could be placed on quality than on quantity in the classification and assignment of personnel. In the second place, the consolidation of the two training commands eliminated a great deal of duplication and resulted in a much needed centralization of authority. Gradually, the most pressing problems incident to control over flow and assignment of personnel were smoothed out at Training Command headquarters at Fort Worth, Texas.

After 1 April 1944 control of student flow and assignment was greatly improved by the adoption of the consolidated training directive (CTD). Consisting of a basic communication and accompanying tabs prepared by AC/AS, Training, the CTD gave figures and dates upon which the Training Command was to base its plans. Approximately two weeks after receipt of the CTD, a report, based on data obtained by the Training Command from its subcommands, was made to Headquarters, AAF showing the number of men in the flying and technical* training pipelines and the number that would be available for meeting commitments. To assist its subcommands in planning to meet future commitments, the Training Command

* The CTD, applicable at first only to aircrew trainees, was broadened to include technical student requirements in February 1945.

issued to them monthly an enlarged condensed flow chart which amounted to a directive, since it enumerated the sources of personnel, set the number to be entered in various training programs, and established the graduation dates.[22] These steps taken by the higher headquarters made it possible to eliminate the snarls that plagued the classification process in the earlier years of the war.

Evolution of Aircrew Classification

The aircrew classification system adopted by the AAF in December 1941 was not a new development. Similar procedures had been in use by the Army air arm for a quarter of a century, although the high educational and physical requirements then in favor and the low quota authorized for the peacetime Air Corps had kept the number so processed small. Still, every effort had been made to improve the procedures for ascertaining characteristics that make for success in military aviation. The advent of war, however, brought a tremendous expansion of the Air Corps and resulted in the adoption of the assembly-line technique in the processing of candidates for aircrew training.[23]

The Air Corps had planned for such an eventuality. A psychological research project for making a study of pilot selection was established in the OCAC Medical Division on 14 June 1941. Six weeks later, an initial program of tests designed to ascertain the psychological characteristics which contribute to success in flying was ready to be administered to aviation cadets at the projected Air Corps replacement centers (aircrew). The original test battery included some standardized tests plus others constructed especially for use in this program. Although test results were to be used for research purposes only, the intent was to develop practical procedures that could be used at the time of induction to identify candidates with the requisite characteristics.[24]

When the first Air Corps replacement center was opened at Maxwell Field, Alabama, on 6 September 1941, a thirty-hour initial processing and military indoctrination schedule was established for incoming aircrew candidates. Authority was granted to include in this schedule six hours for psychological examinations to be given in three periods of two hours each. The on-the-spot administration of these tests was delegated to a psychological research section established at Maxwell Field. Similar sections were later established at San

Antonio, Texas, and at Santa Ana, California. The immediate objective of this research program on pilot trainees was the development of means for measuring those aptitudes, special abilities, and psychological characteristics associated with subsequent success or failure of cadets in flight training. It was planned that after each class had completed its flight training, a statistical analysis would be made of the test scores of the successful and unsuccessful cadets to determine which tests should be retained as predictive devices for the selection and classification of future classes.[25] This research on psychological testing of pilot trainees was begun at Maxwell Field on 13 October 1941. Both written and psychomotor tests were included in the test battery. Psychomotor tests sought to measure such characteristics as steadiness, balance and equilibrium, reaction time, and ability to think clearly and read directions under conditions of confusion. Early test equipment included jigsaw puzzles, mechanical gadgets, and a device consisting of a panel of lights manipulated by a set of airplane controls. Other special machines and apparatus were being manufactured and readied for use during this period.[26]

Meantime, the Air Corps had become greatly concerned over the high elimination rate among bombardier and navigator students. Specialized training programs for these members of the aircrew, unlike that for pilot trainees, were little more than a year old. Previous to 1940 bombardier, navigator, and gunnery training had been an incidental, though necessary, part of the training given to pilots, on whom the Air Corps had always centered its attention and to whom it had given all publicity. But the development of fast, maneuverable, multiengine planes, particularly the medium and heavy bombers, had given new significance to responsibilities other than those of piloting in aircraft which required for their operation aircrews of trained specialists.[27] Originally, it had been planned to utilize as either bombardiers or navigators those eliminated pilot trainees who were willing to volunteer for further training and who could meet the particular educational qualifications required for these specialties. The policy was not working satisfactorily, partly because the morale of eliminated pilot trainees was low, but mainly because of classification experts' ignorance of the psychological characteristics which made for success in bombardier and navigator training.

In the spring of 1941 the Assistant Chief of the Air Corps sought and obtained from the National Research Council results of its

research on the testing of Navy flying personnel, and in May 1941 he directed that a study on bombardier and navigator aptitude be undertaken by the Air Corps Technical Training Command, then located at Chanute Field. The study was conducted during the summer and fall of 1941 by a personnel technician who rode in Army aircraft, inspected and familiarized himself with bombardier and navigator equipment, and tested cadets undergoing training at Barksdale, Maxwell, Ellington, and Kelly Fields, and at the AAF Navigation School at Albany, Georgia. Although the preliminary report of the study was encouraging, it was clear that further experimental testing on a larger number of trainees was needed before the Air Corps could rely upon a test battery for selection and classification purposes. Accordingly, the Technical Training Command continued with its study during the rest of 1941.[28]

While both the pilot-selection project and the bombardier-navigator aptitude study were still operating on an experimental basis, the attack on Pearl Harbor occurred. On 8 December 1941 General Arnold directed the chief of the Medical Division to begin using the new processing tests and gadgets right away.[29] Although the psychologists in the Medical Division had not had time to validate all phases of the testing program, enough data had been analyzed and verified to permit early conversion from a peacetime and experimental project to a wartime classification system. Heretofore, men appointed as aviation cadets had decided the type of training they would receive. Final determination between the alternatives presented was now assumed by the Air Corps rather than the individual. In line with this decision, the Medical Division was given complete responsibility for the preparation of tests to be used in the selection and classification of aircrew personnel and for research connected therewith.[30]

The administration of the psychological testing program was organized as follows: psychological personnel in Headquarters, AAF formulated general plans and directed research; actual test operations necessary to the classification of aircrew members was performed by a psychological research unit stationed at each of the three Air Corps replacement centers. In addition, a psychological section to coordinate the program was established in the office of the Flying Training Command surgeon.[31]

Many problems beset the Flying Training Command in getting the

classification program under way. The replacement training centers at Maxwell and Kelly Fields were so crowded with aviation cadets during the first six months after war was declared that many men had to be housed in temporary "tent cities," and some were even farmed out to nearby airfields until facilities could be provided for them at the centers. The Santa Ana Army Air Base in California was still under construction during 1942. Preflight schools shared the facilities at all three locations. Much of the equipment needed in psychomotor testing was not yet available, and resort was made to devices and gadgets of local construction.[32]

The establishment of separate classification centers for aircrew candidates was recommended by a training conference convened at Randolph Field on 12-13 January 1942. Such installations were to be essentially pooling places where the thousands of civilians coming into the Army for aviation cadet training would receive a physical examination and inoculations and be quarantined for several weeks. During this period cadets would receive uniforms and equipment, be indoctrinated in the ways of military life, and be classified for aircrew training in one of the three specialties, or, if eliminated from aircrew training, be assigned to one of the enlisted combat-crew training programs or to ground duty.

The Flying Training Command desired to locate these "pooling" installations near its training schools which, with few exceptions, were strung out across the nation in the area south of the 37th parallel where weather conditions were most conducive to year-round flying. Moreover, the distribution of population in the United States had to be considered. Training officials therefore wanted one classification center in the vicinity of Nashville, Tennessee, another in Texas, and a third at Santa Ana, California. This division took account of the fact that four-ninths of the total population of the nation would be served by the Tennessee location, three-ninths by a Texas site, and two-ninths by a California site.[33]

The final decision to establish classification centers at Nashville, San Antonio, and Santa Ana was made concurrently with the start of the 50,000-pilot training program in March 1942. The function of these establishments was to be twofold—to serve as processing and classifying units and to enable the creation of reserve pools of classified students. Pools would facilitate the formation of preflight classes, since there would accrue a backlog of classified men to meet

any expansions in the training program. Aircrew candidates would flow into the classification centers at a relatively uniform daily rate; processing would require a minimum of three weeks, and the anticipated average length of time spent there would total twenty-six days. The elimination rate for physical deficiencies and other reasons was estimated at 15 per cent.[34]

Construction of the classification centers began in the spring of 1942. Meantime, processing continued at existing facilities. A temporary classification center was established at Maxwell Field on 25 April and continued to operate there until mid-July when it was moved to its new location at Nashville.[35] At San Antonio the classification center established on 30 April shared facilities with a pilot preflight school on Kelly Field until September when its new quarters in the San Antonio Aviation Cadet Center were ready for occupancy.[36] At Santa Ana the classification center, activated on 15 June, occupied facilities constructed for it at the Santa Ana Army Air Base.[37] Thus, by the fall of 1942 all three classification centers were operating in facilities designed and constructed especially for the purpose of classifying aviation cadets.

The Aircrew Classification Process

Men who qualified for aircrew training were a carefully selected group. After 15 January 1942 the aviation cadet qualifying examination was used in lieu of the former two-year college requirement, and it proved to be an excellent initial screening device. Even so, the number selected by this method turned out to be more than could be successfully trained as future pilots, bombardiers, and navigators. It therefore became possible, and desirable, for the Training Command to apply a second and more sensitive selective screening designed to select only those with a better-than-even chance of success in aircrew training, and to make sure that those so selected were channeled into the specific type of aircrew training in which they had demonstrated the highest aptitude. The task of administering the second selective screening was given to the classification centers.

The method of selection adopted by the Army Air Forces was known as "the classification battery" and consisted of a series of psychological and psychomotor tests prepared by expert professionals. Psychologists first had to decide what abilities or aptitudes promised success in each of the three types of aircrew training. To

this end, a job analysis was performed for each specialty. Information was obtained from every possible source—by talking with pilots, instructors, aviation cadets, flight surgeons, and others acquainted with aircrew activities and difficulties; and by making exhaustive studies of the ground-school courses which these men had to pass, of the planes they had to fly, and of the instruments and controls they had to read and manipulate. In an effort to discover causes of failure, careful studies also were made of the reports on 1,000 aviation cadets who had been eliminated from elementary flying schools.[38]

With these job analyses at hand, tests were constructed which it was expected would measure the extent to which each cadet possessed the required aptitudes. The only way to be certain, however, that each was a valid test was to try it out on a large group, admit all members of the group to training, and then keep score on them during their training career. If the test was a good one, only a small percentage of those who did poorly on it would graduate, while a large percentage of high scorers would do so. Every person who took the battery was given three scores, each of which was used to predict success in one of the chief aircrew positions: pilot, bombardier, and navigator. The three scores varied because the tests composing the battery were given different weights as applied to each of the three aircrew positions. The weights were assigned experimentally at first, but were later derived from actual correlation of results.[39]

Test scores were converted into "stanines." The term was coined from the words "STAndard NINE," and referred to the aptitude rating given each man on a scale that ranged from one to nine. A stanine of nine meant an individual was among those in the top scoring category on tests that predicted probability of success in the specialty for which the stanine was determined; a score of five meant he was in a group scoring in the middle category; a score of one placed him in the lowest category of scorers.

As soon as the psychological research units had accumulated sufficient evidence to demonstrate that stanine scores were reliable criteria upon which to base predictions, authority was granted to use the stanine as a selective device. After 2 July 1942 all men assigned to navigation training had to have a navigator stanine of five or above, and on 28 November 1942 a minimum stanine score of three was made prerequisite for assignment to either bombardier or pilot

training. At first stanines had been used only as a means of supporting recommendations to help determine whether cadets qualified for aircrew training should be trained as bombardiers, navigators, or pilots. When the training pipelines filled up at the end of 1943 and retrenchment began, the minimum qualifying stanine scores were successively revised upward so as to admit fewer aircrew trainees.[40]

Aviation cadets encountered two severe tests during the classification process. The first was a stiff medical examination requiring two days of the cadet's time. Cadets who were found to have defects which under Army regulations could be waived were required to complete a special waiver form. This delayed their final classification until the waiver had been granted. Included also was a psychiatric interview to determine each applicant's adaptability for military aeronautics. When all phases of the physical examination had been completed, the results for each cadet were recorded and the papers were reviewed by medical officers. When approved, these records were transmitted to the surgeon and the psychological research unit for use in preparing recommendations as to the types of training for which cadets were qualified.[41]

Aptitude testing also required two days and usually began about the fifth day after the cadet's arrival. The tests were designed to measure speed and accuracy of perception; ability to read and understand technical information, including tables, charts, and graphs; degree of judgment and resourcefulness in practical problems; and knowledge of general mathematics, of general information, and of mechanical principles. All questions used in the tests were of the multiple-choice type, and those for each test were arranged in separate booklets. Answer sheets were of a special type which could be rapidly checked on electric scoring machines.

Psychomotor tests, unlike the "paper and pencil" tests, were administered to each cadet individually and were designed especially to measure motor coordination, finger dexterity, divided attention, steadiness under pressure, and ability to react quickly and accurately to constantly changing stimuli—in short, the extent of coordination between eyes and hands and feet. Much of the equipment was especially designed and constructed under the direction of the School of Aviation Medicine. During much of 1942, however, because of manufacturing bottlenecks equipment was in short supply, and temporary devices of local construction were utilized. One such

device, the finger dexterity apparatus developed at Santa Ana Air Base, proved so successful that it was adopted as a permanent part of the test battery.[42]

Classification centers soon discovered that cadets accepted the ordeal of classification best when they understood what the processing meant, why it was necessary, how it operated, and that it was a means of protecting the interests of the trainee himself as well as of the government. As a consequence, illustrated booklets were published which explained the purposes, methods, and function of each phase of the program.[43] Trainees were cautioned that all parts of the psychological examinations would have a bearing on the selection for each of the aircrew positions, and that the deciding factor in determining the type of training to be given an individual was the relationship between grades on the different tests. Taken in the aggregate, test scores would show the things the applicant could do best.

Since an applicant would ordinarily do better in a type of training he desired, his own preference remained an important factor in classification. Cadets were told, however, that as a rule the trainee would not be classified for the type of training of his choice if his chances of success in that category were thought to be small. If displeased with his classification, the cadet could appeal to a board of officers.

Classification centers became extremely efficient installations. Carefully drafted schedules stipulated in minute detail every step of the classification procedure and military processing.[44] The scheduled program normally lasted eighteen days, although in some instances it was lengthened to twenty-six. Medical and psychological examinations consumed the majority of the first week, but the processing schedule also included a multitude of required training and indoctrination features—military training, personal orientation, war orientation, mess management (a dressed-up term for KP), and a plenitude of other housekeeping duties. Cadets who had finished classification processing for bombardier, navigator, or pilot training discovered that their remaining days at the classification centers were just as filled as before. Each squadron was carefully checked for degree of military proficiency, and drill periods were much more frequent. In addition, emphasis was placed on physical training as the daily grind of rigorous conditioning exercises got under way. One half-day was also devoted to high-altitude indoctrination in the low-pressure chamber.

Approximately two weeks after the processing program began, each man learned what disposition was to be made of him. Those classified for aircrew training were directed to appear at the personnel office for notification of their specific assignments as pilot, bombardier, or navigator. If satisfied with their assignment, they signed a certificate of acceptance. Those men assigned contrary to their preferences had forty-eight hours in which to appeal their cases to a board of officers. The board also interviewed all cadets who had not qualified for aircrew training before making disposition of their cases. Normally, a cadet was classified and assigned without seeing a board.

In making assignments to aircrew training, officials charged with this responsibility considered three factors, which until late in 1943 were, in order of priority: 1) aptitude, 2) individual preference, and 3) quota availability. Thereafter, assignment officials had progressively smaller quotas to fill, and the order of priority shifted to: 1) availability of a quota, 2) aptitude, and 3) individual preference.[45]

Before taking the psychological tests each cadet filled out a preference blank on which he indicated his first, second, and third preferences as to type of training.[46] The great majority of aviation cadets, however, indicated a strong preference for pilot training and since the need for pilots was preponderant, it was possible to assign most cadets to the type of training which was their first choice. The urge to become a pilot was a natural result of the long build-up which had been given to this phase of air training and coincided with the normal desire of youth for speed and adventure. This was manifest also in the preference which many showed for fighter over bomber pilot training.

At the conclusion of the psychological testing phase of processing, the director of the psychological research unit made recommendations for assignment of each cadet and submitted them to the S-1 (personnel) office for use in making the actual assignment. It was the chief responsibility of S-1 to see to it that quotas were filled.[47] The assignment procedure worked smoothly when quota requirements were in accord with aptitude recommendations and individual preferences. When these factors could not be reconciled, difficulties were bound to arise. In order to make up quota deficiencies, arbitrary assignments were made without regard to the recommendations of the psychological research unit. Students assigned in this manner suffered a drop in morale, became easily disgruntled, and had a

higher rate of elimination. This practice was generally caused by sudden and unexpected increases in the bombardier and navigator quotas.[48] Three developments rectified this situation. By the end of 1942 the classification centers were using minimum aptitude scores to select men for each of the aircrew categories and this meant placing more emphasis on the recommendations of the psychological research units.[49] By this time, too, the bombardier and navigator programs had become better organized and the flow of students to these schools was easier to anticipate. Finally, it should be noted that a good job had been done in selling the public on the importance of the bombardier and navigator positions in the aircrew team. There was a greater willingness to accept nonpilot assignments and this was especially true of those men whose aptitude indicated that they would be more successful in bombardier or navigator training.

The disposition of eliminees at the classification centers followed a fairly constant pattern. The elimination rate at first was low, about 5 per cent, and was caused mainly by failure to meet the physical standards for aircrew training. A rapid rise in the number of eliminees occurred, however, during the latter half of 1942 when minimum stanine requirements for assignment to aircrew training were inaugurated. By the end of that year the elimination rate had more than doubled[50] and it continued to increase with each raising of the minimum stanine requirements.

Eliminees were informed by a board of officers of the alternative types of training available to them. Usually an eliminee was sent to a basic training center for reassignment to gunnery or to technical training in preparation for combat-crew or ground-crew assignment as an enlisted man. Those who could qualify for training as administrators were given the opportunity to be sent to officer candidate school. It was important for morale, both of the eliminee and of the men who had been classified for aircrew training, to dispose of eliminees as quickly as possible.[51]

By midsummer of 1943, eliminees were being reassigned directly from classification centers to gunnery or to technical schools. Those sent to technical schools were to be trained as radio operator mechanics, aviation mechanics, or aircraft armorers. After September 1943 admission to these technical training schools was dependent upon the eliminee's ability to pass tests in four subjects: code, mathematics, mechanical information, and mechanical movement. Those who

passed the tests with the prescribed scores were evenly distributed among the three types of technical training schools.[52]

The inauguration of a college training program for aircrew trainees in the spring of 1943 introduced new problems. Thousands of Air Corps reservists received a call to immediate active duty. After issuance of uniforms and routine processing at basic training centers, the trainees were sent to colleges where they were given from three to five months of academic training. From the colleges the students went to classification centers for aircrew assignment, and thence to preflight school for the type of aircrew training for which the testing showed them to be best adapted.

This procedure was inefficient, however, because many men when tested were found to be unqualified for aircrew training. It was soon realized that the assignment of personnel by selection accomplished most when aptitude testing was done early and the training departments were relieved of inept students. It was suggested, therefore, that men be classified at basic training centers and only those who met the stanine requirements for aircrew training be sent to colleges. This plan, estimated to save over 1,000,000 man-days per month, was adopted and placed into effect following the amalgamation of the Flying and Technical Training Commands in July 1943.[53]

Pre-college testing was begun on 1 November 1943 by seven new medical and psychological examining units. These were installed at basic training centers located at Greensboro, North Carolina; Miami Beach, Florida; Jefferson Barracks, Missouri; Keesler Field, Mississippi; Sheppard and Amarillo Army Air Fields, in Texas; and Buckley Field, Colorado. Shortly after these new testing installations got under way it was announced that the three big classification centers would be inactivated. Aircrew classification ceased at Nashville in March 1944 and at San Antonio and Santa Ana on 31 May 1944.[54] Moreover, the reduced training program, plus the decreased elimination rate in flying training during 1944, made it possible to abandon some of the medical and psychological examination units. By the close of 1944 only three—those at Keesler, Sheppard, and Amarillo Army Air Fields—continued to classify cadets.

Other changes also occurred as the size of training classes began to decline. In the spring of 1944 assignment to a particular type of aircrew training was placed in the hands of an assignment board located at each preflight school.[55] The decision on type of training

was made by the end of the fifth week of preflight training. The new policy took account of the fact that future requirements for specific positions in the aircrew were difficult to gauge. By putting off the actual assignment as long as possible, assignment officials could cut their cloth to fit any desired pattern.

Minimum qualification scores, which were gradually raised during the second half of 1943 as the validity of the testing program became evident and quotas began to decline, were further increased in December 1943. The bombardier aptitude standard was set at 6, plus a navigator aptitude of 5; the pilot minimum was 6; and the navigator was 7. For those who had been eliminated from one type of aircrew training the minimum qualifying score was 7 for reassignment to training in any aircrew category. This high standard was applied to all classes of candidates in October 1944. The minimum qualifying score for bombardiers was increased from 7 to 8 in August 1945.[56]

During the last year and a half of the war a great deal of attention was devoted by the psychological research units to special studies and projects. These included the development of tests to provide criteria for the selection of other members of the aircrew: the radar observer, the flexible gunner, the armorer gunner, and the flight engineer. Studies were also made by special teams sent to transitional training schools and to overseas combat areas where the records of Training Command graduates were examined and data gathered in order to correlate the results of the test batteries and the actual performance record of the individual in his later training or in combat.[57]

The commanding general of the Army Air Forces paid tribute to the program when he said: "The Aviation Psychology program paid off in time, lives, and money saved, and through its selection of the raw material has aided in the establishment of an effective combat air force. This has been done at a total cost of less than $5 per candidate tested."[58] The psychological testing program was one of which both the AAF and the professional psychologists who engineered this mass study of aptitude could well be proud.[59]

CHAPTER 17

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INDIVIDUAL TRAINING OF FLYING PERSONNEL

THROUGHOUT the war a distinction was made between individual training, on the one hand, and crew and unit training on the other. The former prepared students in their individual specialties, such as pilot, navigator, or gunner; the latter taught those individuals to work effectively as a team. After July 1940 individual training of flying personnel was chiefly the function of the three Air Corps training centers, operating under the direction of the Office of the Chief of the Air Corps. In February 1942 this function was delegated to a single Flying Training Command, which, it will be recalled, in 1943 was merged with the Technical Training Command to form the Training Command, with headquarters at Fort Worth, Texas. Combat crew and unit training was conducted from early in 1941 by the four continental air forces; training of cargo and ferrying crews was carried on by the Air Transport Command.

Pre-Flying Training

As had been the case in the First World War, when ground schools for air cadets had been established at selected colleges throughout the country, it became necessary to provide for prospective pilots, bombardiers, and navigators extensive preflight instruction previous to their assignment to flying schools. During the interval between the two wars this had not been necessary. The small peacetime air establishment permitted the setting of high educational requirements for selection of cadets, and sufficient time was allowed for military indoctrination in the flying schools. The rapid expansion that began in 1939, however, presented special problems of military training

for prospective officer-leaders of combat crews, and the early necessity of lowering educational standards for admission to cadet programs forced attention to means whereby a minimum level of academic preparation could be assured. The preflight school provided a solution to this two-sided problem.[1]

In February 1941 the War Department authorized establishment of three Air Corps replacement training centers for classification and preflight instruction of candidates for pilot, bombardier, and navigator training. The official designation of "preflight school" was authorized on 30 April 1942, and the term replacement training center was dropped. By that time preflight schools were in operation at Maxwell Field, Alabama; Kelly and Ellington Fields, Texas; and Santa Ana Army Air Base, California. The school at Kelly Field was soon afterwards moved to an adjoining site, designated the San Antonio Aviation Cadet Center.

There was a difference of opinion as to whether pilot and nonpilot candidates should be assigned to the same preflight school. At first, all trainees were included in the same organization, but soon thereafter separate schools were provided. The general rule of separate, though similar, training was followed until April 1944. By that time the downward trend in the number of students called for consolidation, and the Training Command directed that pilot and bombardier-navigator schools be combined. Students thereafter entered preflight schools with only a general aircrew classification and were not assigned to a specialty until near the end of the preflight course. As the war moved to a climax, the unified school proved more adaptable to the shifting demands for each type of aircrew personnel. In November 1944, when the flow of students had been reduced to a trickle, all training was consolidated in one preflight school at the San Antonio Aviation Cadet Center.[2]

Although agreement existed on the need for some kind of preflying training, ideas regarding the content of the course were vague when the schools first opened. In announcing the decision to undertake such instruction, OCAC stated that the preflight period would consist of "physical training, military training, supervised athletics and the complete processing of assigned students," as well as "additional instruction and training as may be practicable . . . to further qualify trainees for instruction as pilots, bombardiers, or navigators."[3] Brig. Gen. Walter R. Weaver, commanding the Southeast Air Corps

Training Center, leaned toward military discipline and physical conditioning as the primary aims of preflight, and his view was supported by many officers who viewed the academic program as subordinate. Curricular development, however, followed the direction favored by those who stressed the need for technical knowledge on the part of aircrew members. There was a steady increase in the relative amount of time and recognition given to academic subjects, and this phase of the program became the paramount function of the preflight schools. Military training doubtless suffered from this trend, but the development was a logical response to the increasingly technical nature of air combat.[4]

Four weeks was the standard length of training at the replacement training centers until March 1942, when a nine-week course was instituted. Separate curricula were issued at that time for pilot and nonpilot training; the distinguishing feature of the latter curriculum was greater emphasis upon mathematics, target identification, photography, and meteorology. Until 1943 each preflight school exercised broad discretion in executing the prescribed program. The lack of uniform instruction proved a handicap in subsequent stages of aircrew training, and to correct this situation a single curriculum for all preflight students was published in April 1943. Final developments of the course were incorporated in a revision of May 1944, when the period of training was extended to ten weeks.[5]

Under the various preflight curricula, students spent four to five hours daily in academic training. Many students entering preflight were so deficient in the fundamentals of mathematics and physics that considerable time had to be given to rudimentary drills, with emphasis upon problems related to performance of flying duties. Theory was reduced to a minimum, and matter inapplicable to aviation was progressively screened out of the courses. Since ability to use aeronautical maps and charts was basic to flying operations, an elementary course in that subject was also developed in the preflight schools. The course became increasingly practical as the necessary materials were made available for teaching purposes; a large portion of the allotted hours was reserved for student exercises in simulated operational problems which required use of aeronautical charts.[6]

The subject of aircraft and naval vessel recognition slowly gained acceptance in recognition of its combat importance. Early teaching of planes and ships was largely ineffectual because too much was

attempted with too little time and equipment, but by 1943 the preflight recognition program was fairly satisfactory. The time allotted to the course was extended, and the number of visual aids greatly increased. During 1944 and 1945, with an adequate supply of projectors, slides, and screens, the schools were quite successful in training students to recognize, almost instantly, close-up views of the principal American and British aircraft. The scope of naval vessel recognition was gradually restricted to identification of ships by general type, including merchantmen and landing craft, rather than by nationality or individual class.[7]

Pilot trainees, in particular, were unhappy in having to take radio code instruction. It was admittedly a dull subject, requiring concentration and repetition. Student motivation was weakened by the fact that flyers returned from combat generally declared that overseas they had little use for code. Headquarters, AAF, however, repeatedly directed that code be taught, and all preflight students, except those who demonstrated proficiency, had to attend one hour of code daily. By 1944 both sending and receiving of code, by aural and visual means, were taught. The proficiency required was six words per minute.[8]

Of the 175 hours of instruction called for in the official academic program of 1944, 110 were allotted to basic military and officer training. One-half of this time was set aside for close order drill, ceremonies, and inspections; the remainder went to classroom or squadron instruction in customs and courtesies of the service, chemical warfare defense, small-arms familiarization, and related military subjects. The West Point code of cadet discipline and honor was regarded as the model for the preflight schools. The traditional class system, with its more or less stereotyped forms of hazing, was introduced at first, but this practice came under severe public attack, and in spite of its defense by the responsible military authorities, the class system was abolished by order of the Flying Training Command in May 1943.[9] While there may have been disciplinary advantages in the supervision of each lower class by upperclassmen, the hazing associated with the system interfered with the primary mission of the schools and was ill suited to the temperament of the civilian soldier.

Physical conditioning was one of the major purposes of preflight, and after initial uncertainty regarding the nature of such training, a comprehensive and balanced program was evolved. Experimentation

was the rule during the early period, when calisthenics, in varying amounts, were mixed with competitive sports, cross-country hikes, and obstacle courses. In September 1943 a weekly minimum of six hours of physical training was established for all aviation cadets. The trend toward uniform conditioning culminated in November 1944 when the Training Command published a detailed outline of exercises for each stage of aircrew training. This memorandum provided for a steady progression of physical hardening and a specified division of time among standard drills, team games, and aquatic exercises.[10]

The chief problem in developing an effective preflight program was the lack of qualified academic instructors. Because few military personnel were available and they were inadequately prepared as teachers, it was realized that they could not be depended upon exclusively, and in July 1941 authority was granted to hire civilians. Within a year it was recognized that professional training and educational experience were prime requisites of academic instructors, and such men were procured in large numbers. Although these civilians were generally satisfactory, their status as civilians proved troublesome. They were authorized to wear military-type uniforms, but such quasi-military status did not make them feel at home in Army schools. Some of the men, furthermore, were in the process of being drafted by their selective service boards, and others were accepting commissions offered by the Navy. To hold on to these teachers, the AAF in the latter part of 1942 and during 1943 gave direct commissions to civilian instructors at the schools, as well as to several hundred procured directly from colleges, and sent them to the AAF administrative officer training school. Instructors under thirty-five were allowed to enlist and were then assigned to the officer candidate school. Practically all of the men who thus became officers were returned to their preflight teaching positions. In addition, a few instructors who were physically ineligible for commissions remained at the schools as enlisted men, and a small number of civilians were also retained.[11]

Although most of the instructors were experienced college or high school teachers, some had almost no knowledge of some of the subjects they were assigned to teach. In order to deal with this problem, practical in-service training, consisting of classroom observations, individual study of textual materials, and conferences with veteran preflight teachers, was given at each school. Attention was limited at first to preparing each instructor in the subjects he was required to

teach, but programs to improve teaching techniques and develop familiarization with the entire curriculum were later developed. In the summer of 1943 these local efforts were supplemented by a special course at the central instructors school at Randolph Field. After a considerable number of teachers had attended the six-week program there, the course for ground-school instructors was dropped in January 1944.[12]

The typical aviation cadet was an eager learner in preflight school. Ground training in any form was viewed with some misgivings by the average cadet, but he responded willingly to preflight instruction. Pilot and navigator students usually showed the highest morale, because their classification most commonly coincided with their first preference. Many of the bombardier students, up to 1943, were eliminees from pilot training who, required to repeat preflight instruction, naturally resented the delay and repetition of subject matter. In 1943 bombardier morale was greatly improved when it was decided that an eliminee from one type of aircrew training, who had completed preflight, would no longer be required to retake that phase of training. As the war neared its end, the attitude of all students became less inspired. Delays in the progress of training, caused by curtailments in the aircrew program, proved especially disheartening.[13]

The preflight schools formed an integral part of aircrew training throughout the war. In 1943 an additional phase of pre-flying instruction was introduced: the aircrew college training program, which lasted until July 1944. The college program, to put it bluntly, came into existence not so much to meet an educational need as to hold a backlog of aircrew candidates. As has been previously noted,* the AAF had found it advisable in 1942 to recruit aviation cadets in excess of its immediate needs and to hold them in an inactive enlisted reserve until needed. By December 1942 approximately 93,000 men were awaiting classification and instruction, and many of them had been in this limbo for six or seven months. Not only did this extended inactive period discourage some of the men, but the pool of idle manpower received increasing notice from selective service boards and the War Manpower Commission. Accordingly, General Arnold proposed to the War Department that these men be called to active duty and given a period of college training designed to make up educational deficiencies.

* See above, pp. 494–97.

In January 1943 the Secretary of War, after making certain modifications, ordered Arnold's recommendations into effect. The Services of Supply, then in the process of establishing the Army specialized training program in various colleges, was directed to set up aircrew college training as a separate project. The curriculum was planned to cover a five-month period, and all aircrew candidates were to be assigned from basic training centers to the colleges unless they could pass a special educational test. The relatively few who passed this test were sent directly to preflight schools.[14] Special boards within the Flying Training Command made preliminary selection of colleges for the program, and the contracts for instruction, housing, messing, and medical care were later negotiated by the AAF Materiel Command. Implementation of the project suffered because of the haste in which it was conceived and executed; by April 1943 over 60,000 men were in aircrew college training detachments at more than 150 institutions.[15] Since the AAF viewed the college enterprise primarily as a personnel rather than a training activity, it failed to establish a clear definition of its educational purpose. The educational objectives, as stated by the Flying Training Command, varied from a limited "Preparation . . . both mentally and physically, for intensive ground training in the Preflight Schools" to the broader "attempt to diminish individual differences in educational background for subsequent air crew training."[16]

Academic subjects, taught by college faculty members, included mathematics, physics, current history, geography, English, and civil air regulations. Military indoctrination, the responsibility of the officers of each detachment, consisted of drill, inspections and ceremonies, guard duty, customs and courtesies, and medical aid. Military training was carried into the academic phase by having the students march to and from classes and by insisting upon proper military courtesies at all times. Although there was a great variance in the degree of emphasis upon discipline at the colleges, this phase of the program was probably more valuable than any other, in that it at least helped adapt students to the standard regimen of Army training. Physical conditioning, required one hour daily, included calisthenics, running, and competitive sports.[17]

Perhaps the most controversial phase of the curriculum was the ten hours of flight indoctrination. The AAF did not desire this instruction in the college program; it was prescribed by the War Depart-

ment and conducted in cooperation with the Civil Aeronautics Administration. Flying schools located near the colleges provided the training under contract. Since the purpose of this flying was only familiarization, operations were restricted to simple maneuvers in light aircraft, under dual control by instructor and student. AAF observers criticized the training as of little value, charging that the students were "merely riding around for 10 hours." A study conducted in 1944 showed that the indoctrination course helped students materially in the regular primary stage of flying training but gave them no appreciable advantage in later stages. Whatever its long-range value, the course was a morale booster for men who had waited months to learn to fly.[18]

As early as November 1943 moves were made toward liquidating the college program. By that time sufficient aircrew personnel were in the training pipeline, and the backlog of men on inactive status was relatively small. The Training Command took the view that the college program was not essential and that it was creating an unfavorable public attitude by holding combat-age personnel in colleges while fathers were being drafted into military service. In January 1944 entrance of aircrew students into college was cut almost in half, and contracts with many institutions were terminated. In March, as a consequence of the general manpower shortage, the AAF was directed to return to the Army Ground Forces and Army Service Forces all personnel recruited from those branches who had not reached the preflight stage of aircrew training. This order resulted in large withdrawals of students from the college detachments and sealed the fate of the program. Shortly thereafter, the Secretary of War approved its final liquidation by July 1944; since procurement of aircrew candidates had been suspended, there appeared to be insufficient personnel in the backlog to sustain the program beyond that time.[19]

Although the number of enlisted reservists awaiting training had been greatly diminished by the middle of 1944, the general problem of backlogs, or personnel pools, was by no means ended. During the year requests from combat theaters for aircrew personnel declined sharply; entry of students into the flying stages of training was accordingly reduced, and this had created pools in intermediate stages of the training sequence. The Training Command concluded that the best solution to the problem was to distribute personnel from the pools to flying fields for on-the-job instruction. AAF Headquarters

accepted the recommendation and authorized the beginning of on-the-line training, with a dual objective: to provide storage and training of delayed students and to alleviate the growing shortage of regularly assigned personnel at the airfields. On-the-line training was first put into effect in February 1944, and after termination of the college program in July, it became the principal holding device for pre-flying personnel pools.[20]

Higher headquarters provided little guidance in the development of an instructional program for on-the-line students. The Training Command advised only that "trainees will be given duty assignments with aircraft maintenance and servicing where they will get more practical training for their future instruction." Responsibility for implementing the program was left almost entirely to individual station commanders, and this fact resulted in considerable variation in the training. Some commanders reasoned that the students would shortly be returned to the normal sequence of aircrew instruction and gave them slight attention; others saw the possibility of a longer period of delay and devoted a great deal of consideration to their training, work, and recreation.

Some stations offered a few elementary academic courses, but attendance was voluntary; a formal thirty-day mechanic course was established at stations of the Western Flying Training Command. At every field, however, student training consisted chiefly of apprentice experience in aircraft maintenance. Because of the increasing shortage of regularly assigned enlisted personnel, permission was eventually granted to use trainees for administrative and nontechnical duties, as well as on the flight line. Such permission tended to draw students ever closer to enlisted and further from cadet status. As progressive cuts in the aircrew program continued, large numbers of aircrew candidates were transferred to regular enlisted status and classified in their appropriate military occupational specialties.[21]

In no other stage of aircrew training was the problem of morale so serious as in on-the-line training. Lack of an explicit program was partially responsible, but delay and uncertainty concerning the students' future were of primary importance. Each step in curtailing the aircrew program was an added blow to morale. Although many of the trainees eventually reached flying schools, large numbers remained in the pools; by the end of 1944 some men had been in pre-aircrew status for almost a year. Higher headquarters showed concern over

the attitude of such students and explained each curtailment of aircrew training quotas as the result of unexpected combat success. To young and ambitious men this explanation was hardly satisfying; as they moved toward enlisted status, many experienced bitter disappointment and sense of failure.[22]

Pilot Training

Although the importance of other specialties was increasingly recognized during the war, the pilot remained the principal object of Air Corps training. While each member of the aircrew was essential to performance of assigned missions, the general success and safety of the crew depended mainly upon the pilot, who was the aircraft commander. Although the AAF made a substantially successful effort to give all flying personnel due recognition, it properly put flying training in top priority.

Development of a military pilot required a succession of training stages, for it was not feasible to train a man to fly a powerful combat or service airplane without preparation in simpler and less specialized aircraft. During the 1920's and 1930's pilots had received a total of twelve months' instruction, divided into three stages. After 1931 the primary and basic stages were given in an eight-month combined course at Randolph Field, Texas; a four-month advanced course, providing specialization in bombardment, pursuit, observation, or attack aviation, was taught at Kelly Field, Texas. This peacetime system of training was successful in producing a small number of graduates who were both skillful pilots and highly qualified junior officers.[23]

In July 1939 the total instructional time was reduced from twelve to nine months. In the following May, with the war pressure mounting across the Atlantic, the period was cut to seven months. Although the introduction of preflight training in the following year compensated somewhat for the loss of time allotted to flying schools, the seven-month period, which allowed only ten weeks each for primary, basic, and advanced flying, was considered insufficient by existing standards. But national danger required unprecedented steps, and shortly after Pearl Harbor the time for each stage was forced down to nine weeks. In March 1944 each stage was lengthened to ten weeks, and after V-J Day to fifteen weeks. The post-hostilities schedule raised the time for individual pilot training to a level approximately that of the 1930's.[24]

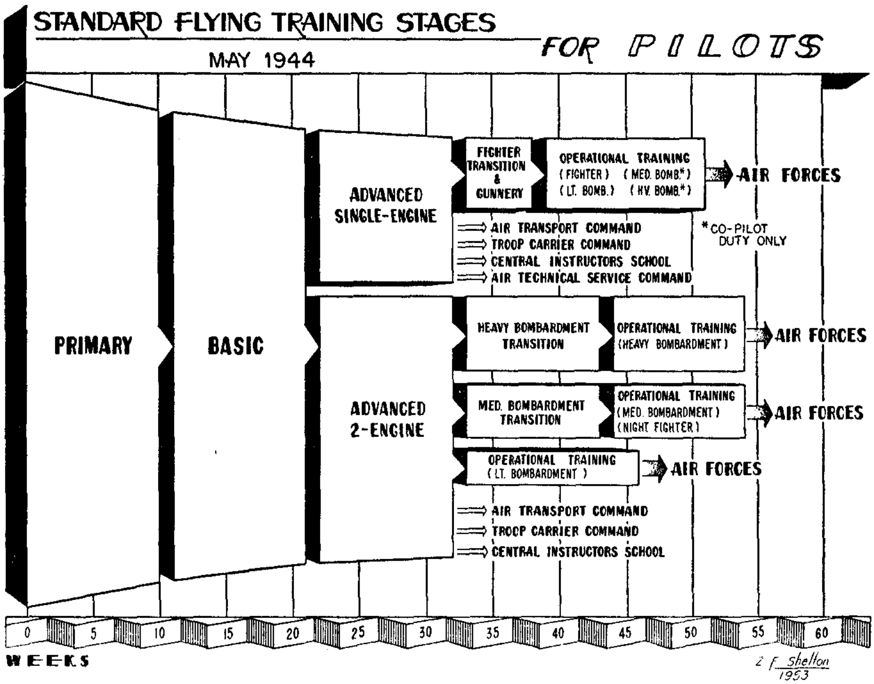
The three stages—primary, basic, and advanced—were common to the training of all Air Corps pilots, and upon graduation from advanced, students received their wings and bars. This step, however, did not signify the end of their training; the new pilots were given additional periods of specialized instruction suited to their military assignments. Such instruction included in all cases a period of transition flying.

The term "transition" was applied generally to a pilot's learning to operate an unfamiliar plane; thus all students underwent several brief transition phases as they progressed through the normal stages of pilot training. In primary they learned to fly a small aircraft of low horsepower; in basic they transitioned to a heavier plane with more complex controls; in advanced they learned to fly a still more powerful machine which approximated the characteristics of combat aircraft. Transition to combat planes, which generally did not occur until after a pilot had earned his wings, was a larger undertaking than previous transitions to training planes. It involved not only learning to fly a complex, high-performance aircraft, but also the acquisition of flying techniques, preliminary to operational unit training. In order to make adequate provision for this step, a special stage, called transition, was evolved in the major pilot programs.

When the Air Corps' expansion began in 1939, transition to combat aircraft was a function of the GHQ Air Force and units in overseas departments; the four continental air forces took over this job and carried it on until 1942. By that time the program had become too large for the air forces alone to direct in addition to their operational unit training. Consequently, transition of pilots to heavy and medium bombardment aircraft was assigned to the Flying Training Command, the agency primarily responsible for individual flying instruction. Light bombardment and fighter transition, however, remained a function of the continental air forces' operational units.[25]

The time allotted to pilot transition to combat planes varied throughout the war, but by May 1944 it was stabilized at ten weeks for bombardment transition. Fighter pilots received five weeks of transition on obsolescent combat types before being assigned to operational units, where they were given transition on current fighter types prior to tactical training. Transition to the specific aircraft to be flown in combat was the last stage of a pilot's individual training. Upon completion of this stage, he was ready to start training as a

member of an aircrew and a combat unit. Crew and unit indoctrination normally required about twelve weeks, after which the aerial teams were sent to staging areas to prepare for movement overseas. Even though the time for primary-basic-advanced training of pilots was reduced during the war to seven months or less, a pilot was not ready for combat until a year or more after he started flying instruction.[26]



Until July 1939 primary training, as well as other phases of pilot training, had been conducted exclusively at Air Corps stations by military instructors. Thereafter, as described above,* the Air Corps depended increasingly upon civilian schools working under contract to provide primary instruction to air cadets; by May 1943 there were fifty-six contract primary schools in operation. At each school the AAF maintained a small military contingent whose services were gradually expanded, but the military element in the activity of these schools was subordinated to the task of learning to fly.[27] The termination of contracts began with the curtailment of pilot training in

* See above, pp. 456–61.

1944, and by the end of the war the responsibility for primary training had been returned to regular AAF establishments.[28]

The instruction given at the contract schools was an adaptation of the primary phase formerly taught at Randolph Field. Although the number of weeks allotted to primary training was sharply reduced, the number of flying hours remained almost constant after the original requirement of sixty-five hours had been trimmed to sixty in March 1942. In that year an unsuccessful attempt was made to add instrument, night, and navigation instruction to the curriculum, but otherwise the program remained virtually the same during the war. As given at the height of the effort, primary flying training was divided into four standard phases. In the pre-solo phase students became familiar with the general operation of a light aircraft and achieved proficiency in forced landing techniques and in recovering from stalls and spins. In the second, or intermediate phase, pre-solo work was reviewed, and precision of control was developed by flying standard courses or patterns, known as elementary 8's, lazy 8's, pylon 8's, and chandelles. The third, or accuracy, phase demanded high proficiency in various types of landing approaches and landings; the fourth, or acrobatic, phase required ability to perform loops, Immelmann turns, slow rolls, half-rolls, and snap rolls. The ratio of dual to solo hours was flexible within the limitation that a minimum of 40 per cent and a maximum of 50 per cent of the total time was to be dual. Each student in primary was required to make at least 175 landings.[29]

It was the mission of the basic schools to make military pilots out of primary graduates; hence, these schools were completely controlled and operated by the military. Although basic flying was conducted by a few private contractors, on a trial basis, from 1941 to 1943 and the experiment met with some success, AAF officials questioned the ability of civilians to teach military flying techniques, and by the end of 1943 curtailment of the pilot program removed any necessity for using private agencies in basic training. The student at basic learned to operate a plane of greater weight, power, and complexity than the plane which he had mastered in primary. In addition, the student was introduced to new aspects of airmanship, learning to fly by instruments, at night, in formation, and cross-country. The military instructors emphasized precision and smoothness of airplane operation, and a large portion of flying time was devoted to repetition of maneuvers to develop proficiency.[30]

After 1939 the basic stage was accomplished in from 70 to 75 hours of flying, as compared with the 100 hours required before that time. It was divided into a transition phase, involving familiarization with the plane and fundamental operations, and a diversified phase, which included accuracy maneuvers and acrobatics, and formation, instrument, navigation, and night flying. Reduction in training time was at first effected by eliminating navigation and formation flights and decreasing slightly the hours allotted to other portions of the diversified phase. In 1940 formation and day navigation flights were restored to the curriculum, and Link trainer instruction was added. Soon after Pearl Harbor, in response to observed combat requirements, increasing emphasis was placed upon the diversified phase, but the change was unsatisfactory, because it allowed too little time for fundamental transition exercises. The root of the difficulty lay in the fact that the nine weeks given to basic from 1942 to 1944 were not enough to permit satisfactory development of proficiency in both phases of training. Since it was impracticable to accomplish the full objective, there was a serious controversy over which phase should receive principal emphasis. During 1943 the curriculum was modified to favor transition at the expense of diversified training and, as might have been expected, graduates showed greater proficiency in the so-called flying fundamentals but were weak in formation and instrument flying. Criticisms of this weakness from combat units brought a change in basic curricular requirements in May 1944, at which time the length of training was extended to ten weeks. Although the hours allotted to flying were held constant, there was a shift of hours within the diversified phase, instrument time being increased at the expense of acrobatics.[31]

Instrument training was doubtless the most important part of the basic curriculum. Experience in combat underlined the necessity of flying at night and under all weather conditions, and such missions required operation of aircraft by instruments. The nature and extent of the instrument indoctrination given to pilots at basic schools were insufficient until late in 1943, partly because of the traditional peacetime attitude of training officers who subordinated instrument work to conventional visual maneuvers. Another reason for this deficiency was the acute shortage of instructional time and equipment; moreover, the system of instrument flying used by the AAF before June 1943 was not the most efficient. The AAF system relied almost exclu-

sively upon the three rate instruments: the needle, or rate-of-turn indicator; the ball, or bank indicator; and the airspeed indicator. Gyroscopic instruments were practically ignored. During 1942 the Navy developed an improved method of instrument flying, the full-panel system, which relied chiefly upon the directional gyroscope and the artificial horizon. AAF instructors who observed the new method found it to be more accurate than the traditional one; hence, the full-panel system was introduced at basic and advanced pilot schools in June 1943. Assistance in establishing the new system was given by officers from the central instructors school (instrument pilot), which had been activated in March 1943 as a means of strengthening the AAF instrument program. During the succeeding year a substantial improvement in the instrument proficiency of basic graduates was achieved; this resulted from standardized employment of the more efficient system, proper training of instructors, procurement of adequate equipment, and allocation of more flying hours to instrument work.[32]

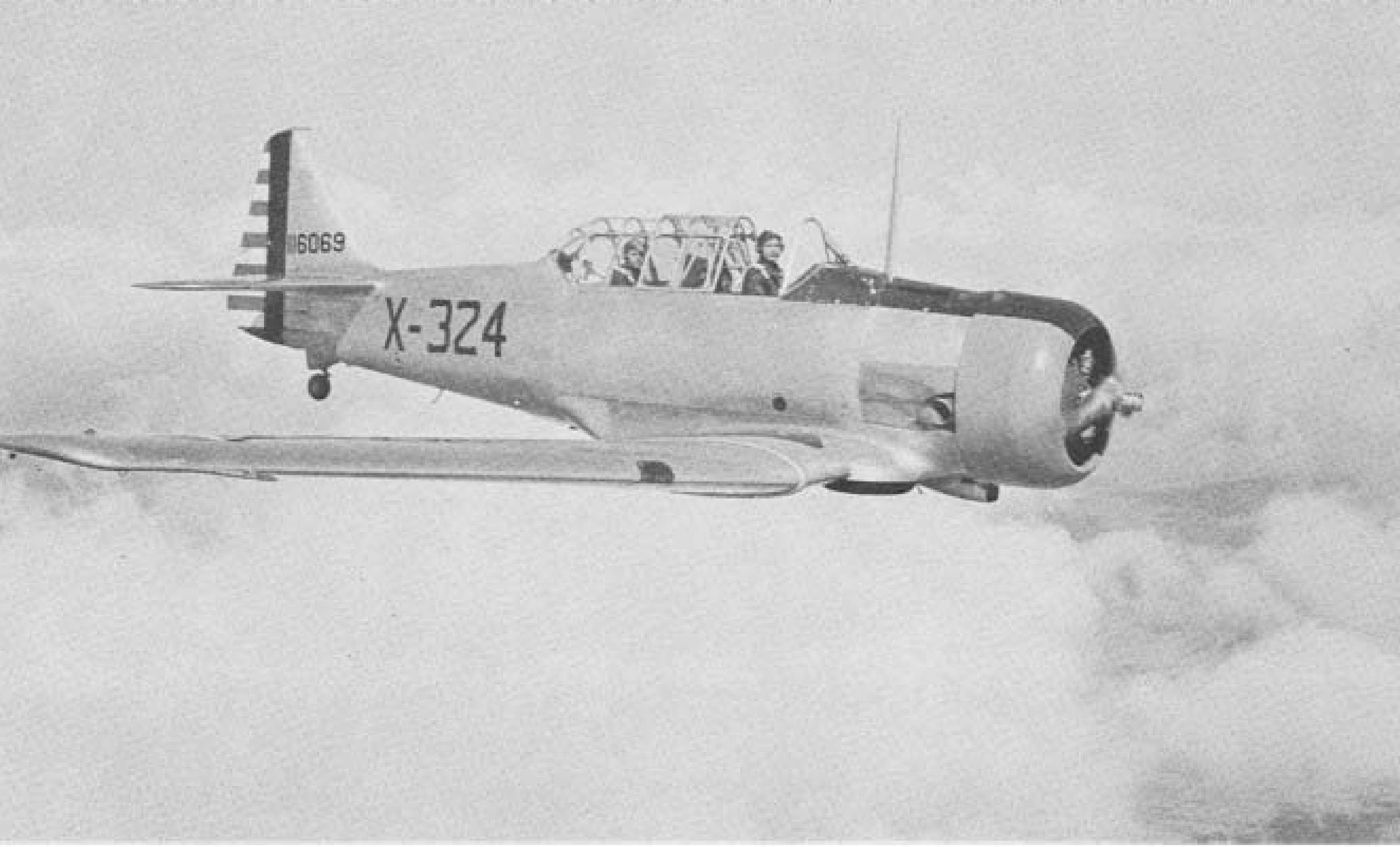
The traditional basic curriculum had always been confined to training on single-engine aircraft; differentiation of students for single-engine or two-engine instruction did not normally occur until advanced training. But during 1943 and 1944 an attempt was made, in the interest of improving the proficiency of multiengine pilots, to begin two-engine training for them in basic. Although the majority of students continued to receive the standard single-engine curriculum, small numbers were entered into one of two experimental curricula. The first of these was a combination course; after transitioning on the single-engine basic trainer, the student received familiarization instruction on a two-engine plane. The second course was conducted exclusively with two-engine aircraft. Although the experimental curricula showed some promise, they were abandoned in 1945. The combination course allowed too little time for the student to gain more than familiarization with either type of plane; the second course proved impracticable because of the shortage of appropriate two-engine aircraft. The experiment indicated, however, that if adequate numbers of satisfactory trainers were planned for and provided, differentiation of instruction at the basic stage would prove more efficient than the conventional curriculum.[33]

Although twin-engine training did not become a permanent part of the basic curriculum, one of the responsibilities of the basic schools

was the selection of students for single- or two-engine advanced training. Assignment was based upon a combination of factors—current requirements for fighter and multiengine pilots, the student's aptitude, his physical measurements, and preference. After the middle of 1944, however, student choice was generally disregarded. Preferences for fighter training exceeded the demand, and there were not enough men with the requisite physical qualifications who desired bombardment. Some schools found it necessary to assign all men with the required physique to advanced two-engine schools.

The differentiation of single-engine from two-engine training in the advanced stage was not effected until the spring of 1942 although planning for the change dated back to October 1940.[34] As it had evolved by 1944, the single-engine curriculum consisted of seventy hours of flying instruction, compared with seventy-five hours in 1939. It included five phases—transition, instrument, navigation, formation, and acrobatics; Link trainer time was also required. Instrument operation was a continuation of the methods learned in basic; the transition, navigation, and formation phases all required night flights. In response to the lessons of war, increasing emphasis was placed on formation flying, especially at high altitudes and using the close, three-plane V-formation. Acrobatics included all conventional combat maneuvers within the performance limits of the advanced trainer.[35] Although some of the graduates of the advanced single-engine school eventually were assigned as noncombat pilots or were sent to bombardment operational training units for service as co-pilots, the principal mission of the school was to prepare students for subsequent flying in fighter aircraft. To achieve this end, the advanced schools stressed the handling of maneuverable, speedy training planes and the development of instantaneous control reactions in students.

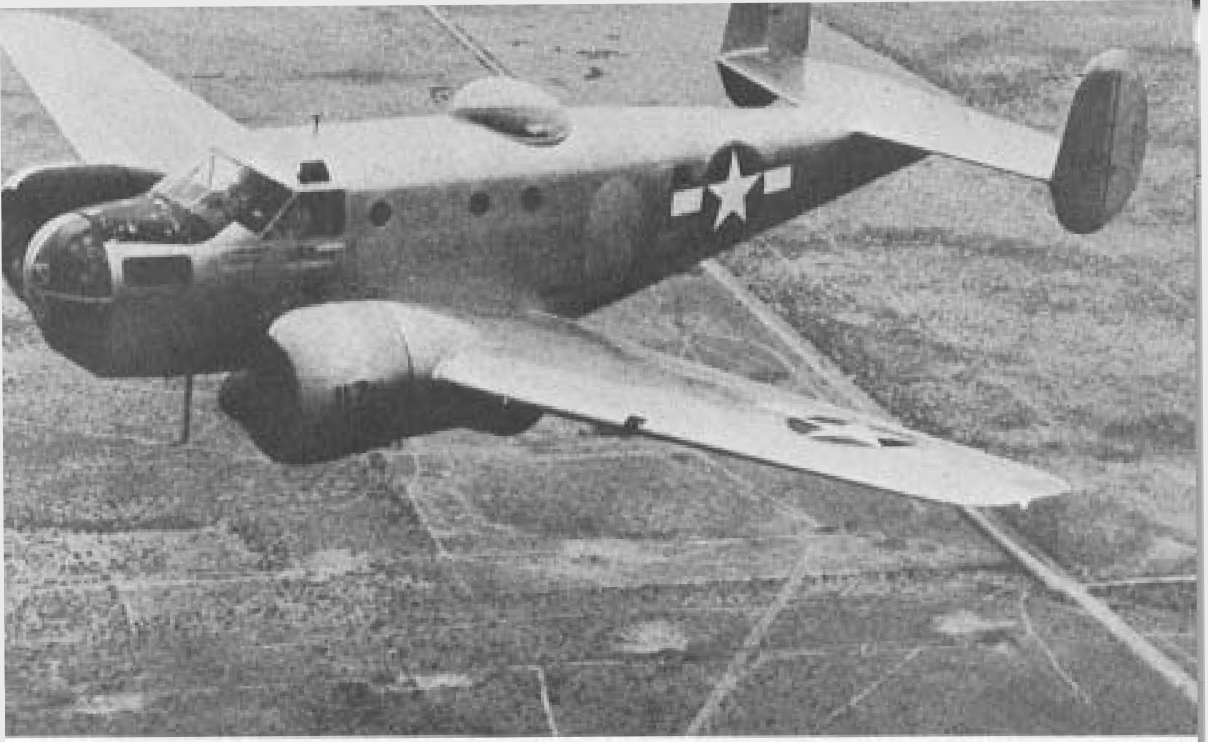
But besides expert flying ability, the fighter pilot needed skill in fixed aerial gunnery. Hence, during the course of advanced training the more promising students, those who were to become combat fighter pilots, were assigned to a fighter-transition and gunnery stage. This preparation for operational unit training consisted of some twenty hours of fixed gunnery practice in the standard advanced training plane and about ten hours of transition in an obsolescent combat type (P-40 or P-39). Development of proper techniques and equipment for fixed gunnery training came slowly, although gradual improvement was noted after 1942 when better teaching methods and use of



BASIC TRAINING: DUAL FLIGHT INSTRUCTION

ADVANCED TRAINING: FORMATION FLIGHT, FOSTER FIELD, TEX.

ADVANCED TRAINING: ALERT NET PROBLEM AT FOSTER FIELD, TEX.



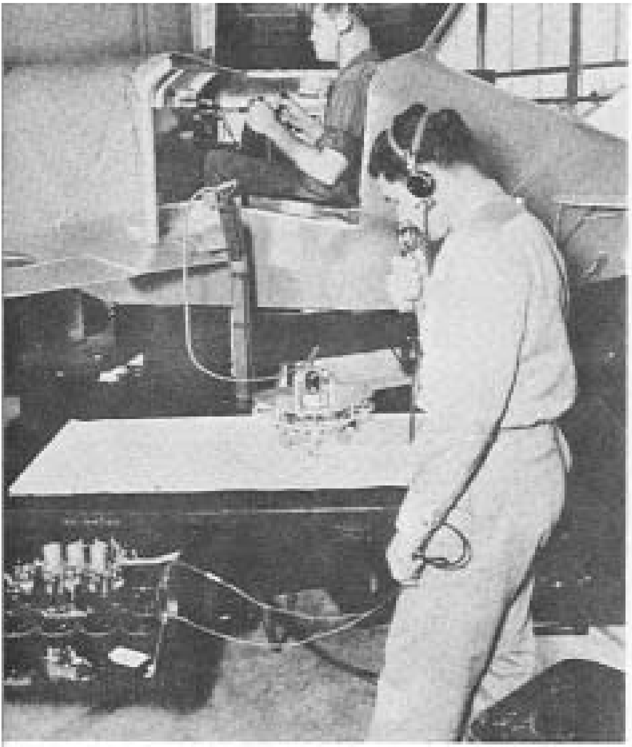
BOMBARDIER TRAINING

Above: Instructor and Cadet in Nose of AT-11

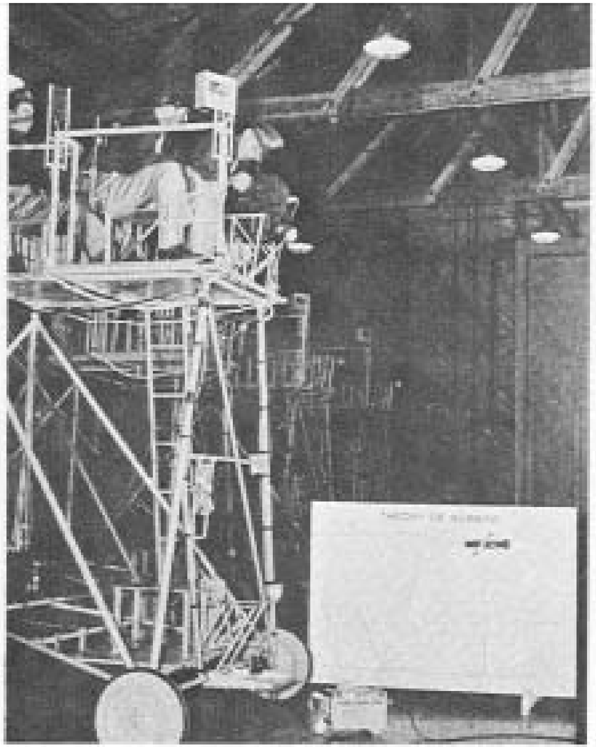
Below: Enlisted Men Prepare for Bomb-spotting Flight

NAVIGATOR TRAINING

AERIAL CLASSROOM



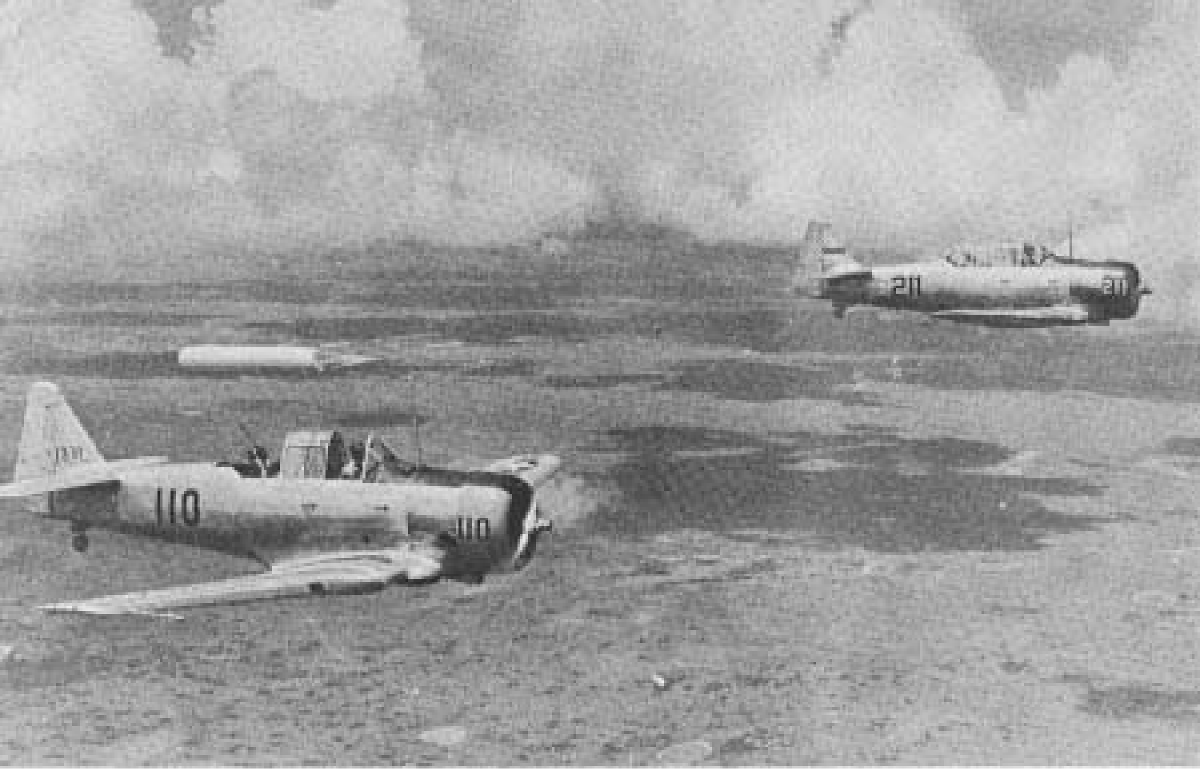
For Navigators: Hagner Planetarium



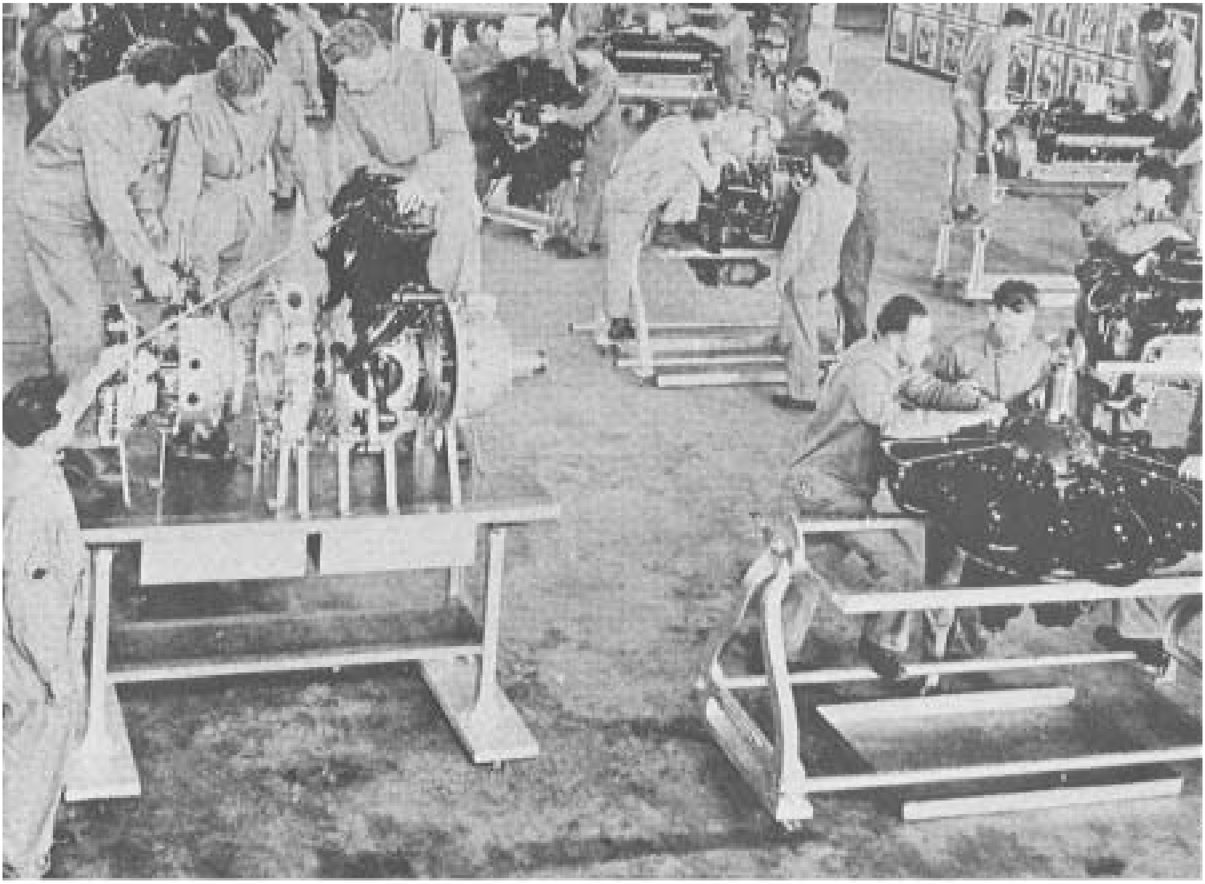
For Bombardiers: A-2 Bomb Trainers

For Pilots: Link Trainer

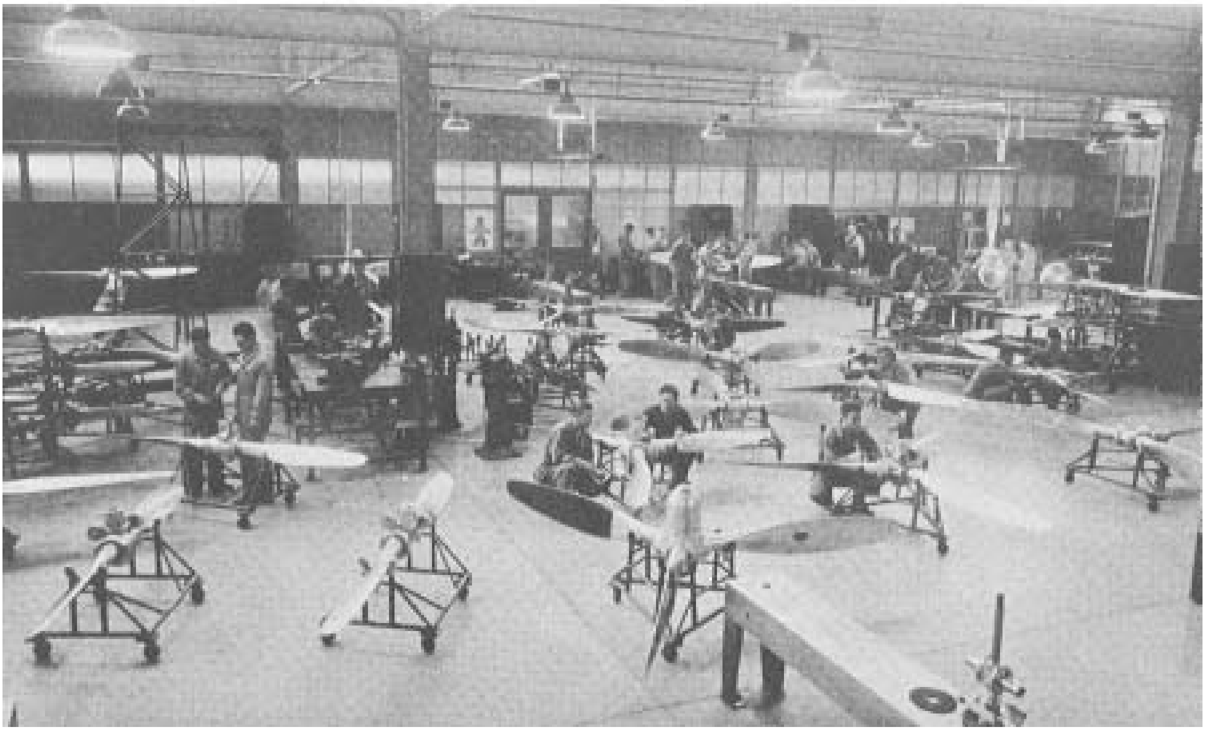
SYNTHETIC TRAINING AIDS



FLEXIBLE GUNNERY TRAINING



ENGINE MECHANIC CLASS, RANDOLPH FIELD, TEX.



synthetic trainers and the gunsight-aiming-point camera had been instituted. In 1944, as the pressure for numbers of graduates eased, the gunnery and fighter-transition phase were made into a separate course to be taken after graduation from advanced. This change lengthened by five weeks the over-all period for training fighter pilots.[36]

Although advanced two-engine training did not begin until the spring of 1942, it expanded rapidly thereafter in response to the growing demand for multiengine pilots. All students, except a few chosen to become night or two-engine fighter pilots, were marked for assignment to bombardment-type aircraft. The number of hours and types of flying instruction were the same as in the advanced single-engine course. The principal difference in the two-engine course was the absence of training in acrobatics and the greater emphasis on instrument work; all flying was conducted in two-engine planes.[37]

Upon graduation from advanced two-engine schools, pilots were assigned to transition training on specific combat types. Beginning in 1942, transition for medium and heavy bombardment was conducted by stations of the Flying Training Command; the Third Air Force continued to provide transition for light bombardment as a part of operational unit training. Separate schools were established for each type of airplane; the first of these, for B-17 transition, opened in March 1942. Initial attempts to conduct full combat-crew training at these schools were abandoned in August 1942, and instruction thereafter was confined to transition of first pilots only. An independent program for co-pilot transition was carried on at selected gunnery and technical schools of the Training Command from 1944 to April 1945.[38]

Until the fall of 1942 entrance into bombardment transition was restricted to pilots with at least one year's flying experience. When it became necessary to train recent graduates of advanced schools, the instructional period had to be doubled in length; by May 1944 it amounted to ten weeks. Although some differentiation for each type of aircraft was found to be desirable, the flying curricula, each of which prescribed about 100 hours of flying, were generally similar. Instrument, navigation, and high-altitude training received increasing attention in the four-engine schools; formation flying was emphasized in two-engine transition. Toward the end of the war, closer liaison was developed with the combat air forces in order to adapt instruction to the changing requirements of the air war.[39]

Ground training, from primary through transition, was an essential

aspect of the instruction received by AAF pilots, instruction designed to prepare the student for successful performance of flight duties. Although air and ground indoctrination were inadequately coordinated at first, a satisfactory integration was achieved by 1944 through more careful planning of the curriculum and frequent conferences between the teaching staffs of the air and ground departments. Mutual understanding was advanced by encouraging familiarization flights for ground instructors and classroom observations by flying instructors.[40]

When the accelerated training program was begun in 1939, the ground curricula at the various stages of instruction consisted of a large number of short courses. For several years thereafter, directives from the higher commands remained vague as to requirements, and each school consequently had a more or less individual curriculum. Continuity of subject matter from one stage to the next was lacking, and considerable duplication between stages prevailed. Gradually, a more orderly sequence of ground training was developed,[41] and by May 1944 the program had become relatively well stabilized at each stage of individual training. Five major courses, calling for a total of ninety-six hours, were given at the primary schools. Almost half of this time was devoted to the aero-equipment course, which was devoted to the principles and workings of the various operating systems of an aircraft. Navigation, the next most extensive course, was a continuation of the maps and charts course taught in the preflight schools and emphasized planning for cross-country flights. A course in principles of flight consisted of elementary applied physics, with special reference to airplane structures and flight behavior. Continuation training in aircraft and naval recognition, as well as in radio code, was also provided. In all courses theory was held to a minimum, emphasis being upon teaching the student how to perform necessary operations.

Pilot trainees received their first instruction in weather during the basic stage. They were also then introduced to the principles of instrument flight, because it was in the basic schools that students learned to fly at night and under all weather conditions. Radio communication procedures were taught at this stage, and the sequence of training in aircraft and naval recognition aimed at achieving proficiency in identifying relatively distant views of the principal planes and vessels.

Ground school at the advanced stage was similar for both single-engine and two-engine trainees. It included the same amount of in-

struction in weather, taking up the subject where it was left at the end of the basic stage. Further ground training on flight instruments was also given to both types of students, as well as a course in flight planning. The chief difference in the two curricula was in the aero-equipment course, which, since the two-engine was more complex than the single-engine trainer, was given more time at the two-engine schools. Single-engine students, on the other hand, received training in armament and fixed gunnery, which was not required for two-engine pilots.

Technical instruction did not end when students received their wings and were assigned to transition on specific combat airplanes. Both fighter and bomber pilots, while undergoing transition to their combat planes, received appropriate ground instruction in equipment and practical maintenance. Intensive training in armament and fixed gunnery was given only to fighter pilots; the multiengine pilots received special instruction in weather, radio equipment, aircraft weight and balance, bombing-approach procedures, and duties of the airplane commander.[42]

Although graduates of its pilot schools were officers as well as flyers, in the wartime pressure to produce pilots rapidly the AAF paid but scant attention to their military training. The atmosphere of the civilian-operated primary schools was not conducive to the development of rigid discipline, and too little time was available for military instruction at all the stages of pilot training. What instruction there was, over and above the regimen of Army life, was restricted largely to marching, ceremonies, inspections, and military customs and courtesies. The vigorous physical conditioning which began in preflight schools was, however, continued and intensified during flying training.[43]

The method of teaching men to fly military aircraft remained fundamentally the same from 1939 through 1945. The sequence was this: explanation by the instructor of each new maneuver, actual demonstration by the instructor, supervised student performance, correction of student errors, and then practice. Progress checks by supervisors were made at specified intervals; final checks, toward the end of each stage of training, tested the ability of the student to operate the airplane under all required conditions. The student, so far as practicable, was taught by the same instructor through all the lessons of a particular training stage. Departure from this "all-

through" system was tried experimentally during 1943 as a possible means of accelerating training. Under the new plan, the flying curriculum at a given training stage was divided into a series of phases, with instructors assigned each to a particular phase. The student could advance individually through the progressive phases as rapidly as his proficiency would permit, and he had a different teacher for every phase. The advantage of the plan was that it permitted the instructor to concentrate on teaching a limited number of maneuvers, with a resultant increase in his teaching skill. The principal disadvantage came from the fact that frequent change of instructors made it difficult for both students and teachers to develop the mutual understanding which facilitates learning. It was finally decided to abandon the experiment, chiefly because it caused serious scheduling difficulties and required a higher ratio of instructors and airplanes to students than the standard "all-through" plan.[44]

Ground-school instruction depended primarily upon classroom lectures, demonstrations, and discussions. Some courses, such as radio code and aircraft recognition, consisted mainly of aural or visual drill. Training aids were used as available, but during the early period of the war these were limited almost entirely to what could be produced locally. After 1943 the situation was considerably improved, and the Training Command produced and distributed manuals and handbooks for both instructors and students. Special emphasis was placed upon mock-ups of operational equipment, and standard sets of such aids were prepared. During 1944 and 1945 increasing numbers of effective training films, slides, and charts were also made available.[45] The most important synthetic device used in instruction of pilots was the Link trainer—a machine in which students could simulate blind flying by means of instruments; it was regulation equipment at every school where instrument flying was taught.[46]

Indoctrination of new teachers, as well as in-service training for experienced teachers, proved to be a continuing necessity in the pilot-instruction program. In the early period the individual schools provided training of a sort for instructors, but by the close of 1942 each subcommand of the Flying Training Command had established a single instructor school for personnel within its jurisdiction. It will be recalled that, in the interest of standardizing training methods and content throughout the command, these regional schools were supplanted in 1943 by one central school at Randolph Field, where various instructor programs aimed to establish and demonstrate stand-

ard instruction for the various phases of student training. Courses corresponding to each of the regular stages of pilot training were given to flying instructors; they consisted of both classroom and air indoctrination. Special courses for ground-school instructors and military training officers were also conducted. Some attention was given also to general teaching methods, psychology of learning, and analysis of flying maneuvers, but these courses were not very effective. The major weakness of the central instructors school appeared to be its inability to secure and retain the best qualified personnel as staff instructors. Soon after the Randolph Field courses were started, a second central school for the exclusive training of instrument-flying instructors was established at Bryan, Texas. In addition to these two central schools, supplementary instructor-training programs were conducted at the individual pilot schools until the end of the war.[47]

The principal item of equipment in pilot training was, of course, the airplane itself. Almost all of the schools were hard pressed by the shortage of trainers until after 1943, and it was necessary to use some models which were hardly satisfactory but, being the only ones available, had to be used. Full conversion to the most appropriate models was not accomplished until the spring of 1945.[48] Among primary training planes, the Stearman PT-13 was eventually selected to replace all other primary trainers. A biplane, and thus different from later trainers and combat types, the PT-13 had the special virtue of ruggedness, a quality not to be despised in a plane that had to take the punishment inflicted by a novice.[49] During most of the war period, the Vultee BT-13, a low-wing monoplane of medium horsepower, served as the standard trainer for basic flying. Regarded by many as altogether too easy to fly, it was being replaced during the latter part of the war by the AT-6, a low-wing monoplane already in use as the standard trainer for advanced single-engine instruction.[50] No suitable training plane became available for advanced two-engine flying until late in the war, when the B-25 was modified for the purpose. Theretofore, the Cessna AT-17 and UC-78, the Beech AT-10, and the Curtiss AT-9 were used, with the last considered the most satisfactory.[51] In the transition stage, combat models, which could not always be the latest, were usually stripped down and flown without full fighting equipment.

A total of 193,440 pilots was graduated from AAF advanced flying schools between 1 July 1939 and 31 August 1945. The number under instruction increased very rapidly from 1939 until 1943; the

peak was reached in December 1943 when over 74,000 students were in the various stages of individual pilot training. By contrast, the total number remaining in August of 1945 was only about 5,000.[52]

Successful completion of pilot training was not easy. During the period from 1939 until V-J Day more than 124,000 students failed to complete the primary, basic, or advanced stage of pilot instruction. This figure, which included fatalities, amounted to almost 40 per cent of the number that entered the flying course. The proportion of students eliminated, as would be expected, was highest in primary training and lowest in advanced. No fixed elimination rate was ever imposed from above; a variety of factors determined the number of failures in a given class at a given school. One determinant, of course, was individual differences in the aptitude and motivation of students; another was the varying quality of instructors and training facilities. One of the most important causes for variation in the elimination rate was the fact that judgment of flying proficiency had to be subjective. Teachers and supervisors established differing criteria of proficiency, and no truly objective form of measurement was developed during the war period. But the aptitude of the students and the quality of instruction did not alone cause the elimination rate to fluctuate—the training establishment was also sensitive to the attitudes of higher authority. The Army Air Forces desired pilots of the highest skill consistent with the demand for numbers and the supply of eligible young men. Whenever substantial backlogs of trainees accumulated and the personnel requirements of combat units appeared to be stabilized, higher headquarters stressed rigid maintenance of proficiency standards. When, as a result of this policy, the over-all pilot elimination rate rose to a point considered excessive, higher headquarters impressed upon all training establishments the necessity of reducing manpower wastage. This policy constituted a realistic, if crude, means of compromising the conflicting needs for quality and numbers of pilots.[53]

The students eliminated from pilot training were not lost to the AAF, since most of them were reassigned to other types of instruction or service. The majority of those who had the qualifications were sent to bombardier or navigator schools. If not so qualified, they were assigned to other combat-crew positions, which normally required courses in flexible gunnery and one of the various companion specialties, such as airplane mechanics.[54]

Bombardier Training

While the Air Corps had a splendid heritage of experience to build upon in the wartime training of pilots, it had no such advantage in developing instruction for bombardiers. Before 1940 the training of bombardiers was limited to on-the-job instruction in operational bombardment groups, both in the United States and at overseas bases. A small number of the trainees were pilots, but the majority were nonpilot enlisted men. Plans had been under way as early as 1939 for the establishment of a specialized school for individual bombardier training, and a course for instructors was established at Lowry Field, Colorado, in July 1940. It was not, however, until late in 1941 that training of students in specialized bombardier schools began. At first the effort was made to conduct this training at fields where advanced pilot training was being given, but by the end of 1942 it was generally agreed that it was more satisfactory to conduct only one kind of training at one station. Specialized schools were established as rapidly as facilities would permit, and they expanded to meet the rising flow of students during 1942 and 1943. The students, who had received aircrew preflight training before entering these bombardier schools, were given a twelve-week course until the middle of 1943; as soon as combat requirements for bombardiers declined, the course was lengthened to eighteen weeks. By 1945 it was possible to provide twenty-four weeks of advanced individual training.

In addition to this specialized instruction, bombardier students from 1942 on were required to take a regular six-week flexible gunnery course. This training was received either before or after the bombardier course, depending upon when it could best be scheduled by the gunnery schools. Upon completion of training in gunnery and bombardiering, the students, who had become rated officers upon graduation, were assigned to one of the continental air forces for crew and unit training. When there was a shortage of bombardier graduates coming into the operational units, the continental air forces completed their crews with enlisted men who had received individual bombardier training in their own units. This program distracted from the primary mission of the air forces, which was unit training, and it was generally considered to be less efficient than the individual instruction conducted in regular specialized bombardier schools.[55]

Although most of the bombardiers who were trained up to the middle of 1943 were qualified only in that specialty, plus flexible gunnery,

plans persisted for dual bombardier-navigator training. It was believed more efficient to carry as part of the bombardment team a man who was both navigator and bombardier, and the crews specified for the very heavy bombers (B-29 and B-32) called for two fully qualified bombardier-navigators. The chief obstacle to this training goal during the early part of the war was the chronic shortage of men trained in one or the other of the specialties, and it proved difficult to keep for supplementary instruction a man already qualified and needed elsewhere. Another hindrance was the difficulty of securing men who were capable of being trained in both bombardment and navigation. As a result of these major deterrents, the AAF repeatedly postponed inauguration of its dual training plans, which had been in existence since September 1941. Insistent demands continued to be made, however, for some type of bombardier-navigator course. During 1942 small numbers of qualified navigators were given an abbreviated course on the D-8 (low-altitude) bombsight and were then assigned to medium bombardment units as "navigator/D-8 bombardiers." In the early part of 1943 a short supplementary course in dead-reckoning navigation was given to a small number of qualified bombardier graduates. Complete dual training—to produce "precision bombardier/celestial navigators"—was initiated in January 1943 and was continued on a limited scale. In July the regular bombardier curriculum was enlarged to include dead-reckoning navigation; this change appeared to be the most feasible answer to the demand for some form of dual training.[56]

One of the principal criticisms of early training was the lack of attention given to analysis of the causes of bombing errors. Bombardier graduates appeared in general to be deficient in knowledge of their equipment and inaccurate in making fundamental computations. Shortages of qualified instructors and proper equipment, and lack of training time were considered to be the chief causes for the deficiency.[57]

After numerous conferences, a standard eighteen-week course was adopted in June 1943 and continued in effect, with minor variations, until the end of the war. The ground instruction, which was the foundation for air exercises, consisted of some 425 hours. The largest portion of this time was given to critiques of air missions and preflight inspection of bombing equipment. Other parts of the ground training dealt directly with bombing and bomb equipment. The most impor-

tant of these were on basic theory and bombsights; students became acquainted with the forces acting upon a falling projectile and with the principles of a bombsight. Both Norden and Sperry sights were studied until 1944, but beginning in that year instruction was limited to Norden equipment. Another subject was bombing accessories, which included the study of bomb racks, fuzes, aerial cameras, and radio. Separate courses were given on flight instruments and the elements of bombsight maintenance and calibration. In the course on bombing procedure most of the student's time was spent on a synthetic bomb trainer which served as a device for transition from ground to air training. A special course was also devoted to the C-1 automatic pilot which the bombardier normally operated during actual bombing runs. Analyzing results of practice bombings and explaining scoring methods made up the bombing analysis course, and the basic AAF doctrines of employment of air power were expounded in a course called bombardment aviation. In addition to the subjects related only to bombing, some dealt with elementary navigation. Training was given in pilotage, dead reckoning, and computers; the graduate bombardier was therefore qualified in elementary navigation as well as in his primary specialty. Several courses common to the preparation of other aircrew members—weather, flight planning, oxygen indoctrination, aircraft and naval recognition, and continuation practice in radio code—rounded out the ground-school curriculum. Military instruction and physical conditioning were practically the same as in pilot training.[58]

Air training, eagerly anticipated by the bombardier students, did not begin until after three weeks of preparatory ground instruction. It consisted of a total of some 120 hours and was divided into two parts: the instructional and qualification stage, and the combat stage. On his first several flights the student learned the feel of the bombsight in the air. He made several dry runs over simulated targets without having any bombs in the plane. For about a week he flew over practice ranges, developing his ability to sight by aiming at various ground objects—bridges, farmhouses, roads, factories, and the like. Practice bombs were then dropped, under close supervision of the instructor. If the student's progress was considered satisfactory, he was permitted to bomb for record and qualification; otherwise he was subject to elimination or further preparatory training. Ordinarily, about 100 bombs were dropped during the qualification phase of the

bombardier's training. At least seven record missions, four by day and three by night, were required; in order to qualify for the combat stage, the student's average circular error for these missions could not exceed 230 feet (when converted to an altitude of 12,000 feet). Bombing runs during the qualification phase were generally from two to three minutes in duration.

The combat stage of training tried to improve bombing proficiency and to simulate the diverse conditions which could be expected in combat. Some sixty bombs were generally dropped during this phase, thirty of them without the instructor present in the airplane, and all releases were scored for record. Circular error was the basis for scoring until early in 1943, when the method was changed to counting only hits and misses. It was believed that the latter method provided a stronger incentive for the student to strive for the greatest possible accuracy. The required standard of proficiency, established in 1943, was a minimum of 22 per cent hits. Combat training missions were exacting; continuous evasive action by the pilot of the aircraft was required within a ten-mile radius of the target, and final approaches had to be straight and level and could not exceed sixty seconds.[59]

Most combat missions were flown with the aid of the C-1 automatic pilot, a device for keeping the aircraft on a set course. The bombardier, as he prepared to make his run, engaged a clutch on his bombsight which gave him control of the plane's direction. As he made adjustments on the sight in order to hold the hairline on target, the aircraft was automatically guided to the required course. A certain number of manual missions were also flown. These were accomplished with the aid of the pilot's directional indicator, which was first zeroed by the bombardier when the plane was lined up on a collision course with the target. The pilot then made the necessary adjustments of stick and rudder to hold the indicator on zero. Not until 1944 did it become possible to provide enough cameras to permit all scoring to be done by photographic record.[60] During 1943 and 1944 interest was stimulated by bombing contests among the several schools.[61]

The bombardier schools had difficulty, as did practically every military training program during the war, in procuring adequate training staffs. Instructors were needed for ground classes as well as for the air phase of training; some military personnel with flying experience were made available for these assignments, but most of the instructors were commissioned directly from civilian life or were

drawn from the ranks of graduating classes at the schools themselves. Equally as important as the instructors were the bomb-approach pilots. The effectiveness of the bombardier was dependent in large measure upon the proficiency exercised in piloting the airplane; this held true not only when the pilot controlled the plane manually, but even when the automatic pilot was used. In both instances the pilot needed to understand the bombing problem and how to operate the equipment successfully. A general policy was developed of rotating experienced bomb-approach pilots to operational units and replacing them with new graduates of advanced two-engine pilot schools.[62]

Training manuals, books, films, and mock-ups were produced with considerable success in the bombardier program. Most of these materials, as well as ground school teaching outlines, were at first prepared locally; during the latter part of the war numerous aids were produced at higher headquarters for distribution to the schools. One of the most generally used mock-ups was a device to demonstrate bombing theory; it showed the influence of airspeed, altitude, drift, and other factors upon the course of a falling projectile. While devices such as this one had the advantage of arousing student interest, many instructors believed that the same principles could be taught as easily by using the blackboard or other simple techniques. Instruction on particular items of equipment, such as the C-1 automatic pilot, was generally conducted on working models of the equipment involved. Giant-sized mock-ups were sometimes built, so that large groups of students could be taught simultaneously.[63]

The most important synthetic device used in the bombardier program was the A-2 bomb trainer. This consisted of a steel scaffold about twelve feet high. It was mounted on wheels and could be electrically propelled across the floor of the hangar, where the trainers were usually kept. The top of the structure represented the bombardier's compartment of an airplane, including the actual bombsight, and was large enough to accommodate the instructor, a student bombardier, and another student who acted as bomb-approach pilot. A third student sat in the lower section of the scaffold and operated a movable "bug" (an electric motor on wheels), at which the bombardier aimed his sight. The "bomb" released was a small plunger that struck a paper target on the "bug," thereby registering the student's accuracy.[64]

As in the pilot program, the need was recognized for training of instructors in desired techniques. Eventually a central instructors school (bombardier) was established at Carlsbad Army Air Field, New Mexico, and later moved to Midland Army Air Field, Texas. It conducted advanced courses for regular bombardier instructors and refresher courses for bombardier returnees, some of whom were assigned to teaching duties. Although some attention was given to teaching methods, the principal part of these courses treated the subject matter of the standard bombardier curriculum. The work of the central school was supplemented throughout the war by local training courses at the bombardier schools.[65]

The standard bombardier trainer during the war was the Beech AT-11, a two-engine, low-wing, all-metal monoplane. It carried an adequate bomb load, and its flying characteristics were suitable for use of the Norden sight and the C-1 autopilot. Major deficiencies of the AT-11 were its altitude and range limitations. A further drawback was the fact that the trainer did not respond in flight as would a heavy bomber; graduates of the bombardier schools therefore had to make a considerable adjustment in technique when they were assigned to the heavy bomber units.[66] The AAF bombsight, rather than the training plane, was the cardinal item of equipment in bombardier schools, and it was required both for air and ground instruction. Several types of sights were used: the Norden M-1 and Sperry S-1 precision sights, and the D-8 and T-1 nonprecision types, but the Norden was the sight in most general use.[67] Although several kinds of practice bombs were used, the type most commonly dropped was the 100-pound, sand-filled M38A2. Bomb targets were of various outline shapes until 1944, when all except circular targets were discontinued.[68]

The number of students assigned to specialized bombardier instruction in the Flying Training Command increased rapidly from 1941 until the middle of 1943; following a slump in enrollment for several months, the number moved up again to a wartime monthly peak of over 2,000 students in training in September 1944. After that time the number in training declined sharply until the end of the war. During the entire period a total of over 45,000 bombardiers was graduated; this figure does not include several thousand who were given instruction outside the Training Command in operational training units.[69]

Procurement of qualified trainees was one of the most difficult problems in the bombardier program. Hardly any of the applicants for aircrew training, most of whom desired to be pilots, wanted to become bombardiers. In order to rectify this unbalanced situation, the AAF conducted a publicity campaign to glamorize the position of bombardier and other members of the combat crew; the role of the pilot was de-emphasized. By means of press releases, books, films, and radio broadcasts the campaign produced favorable results by 1943. In the meantime, however, eliminees from pilot training were the principal source of students. These men, most of whom had been washed out in primary flying, were offered the option of entering bombardier instruction. Although this policy was necessary in order to fill training quotas, it was strongly criticized by many Air Corps authorities. The pilot eliminee often was a serious morale problem because of failure to attain his first goal, and because he was inclined to regard his new status with resentment. By the time this student reached operational training, he had usually become adjusted to the role of bombardier, but his efficiency in training was lessened because of the initial attitude.[70]

No rigid policy for elimination of unsatisfactory students was established in the bombardier schools. The principal cause for elimination was unsatisfactory performance in the qualification stage of air training; students who were deficient in ground instruction, but who could bomb well, were usually held over at the school for additional ground classes. The method of measuring bombing proficiency was more objective than was that for flying proficiency in the pilot program. Various factors, including the immediate demand for graduates, influenced the elimination rates in bombardier training. They fluctuated from a low of 3.3 per cent for one class to a high of 26.1 per cent for another. The average rate for all graduating classes during the war was about 12 per cent.[71]

Navigator Training

Before 1933 instruction in navigation was given only as part of pilot training. After 1933, though some specialized instruction was provided in combat units, the small number of long-range aircraft in the Air Corps required only a few specialized navigators. Even in 1939 plans called for only about 500 officers to be trained in that classification. In drafting these plans it was assumed that all individual

training of navigators would be conducted in specialized Air Corps flying schools, but no such organizations were in operation until 1941. Meantime, besides continuing training in combat units, the Air Corps sent students to Coral Gables, Florida, for specialized instruction by the Pan American Airways System. Navigation training was also started on a temporary basis at Barksdale Field, Louisiana, in November 1940. Toward the close of 1943 individual navigator training by the AAF was consolidated in four specialized schools of the Central Flying Training Command, and after September 1944 the contract with Pan American Airways was discontinued.[72]

Beginning in 1942 navigator trainees were given flexible gunnery instruction in addition to their specialized training. On occasion, the quotas for both bombardiers and navigators at gunnery schools had to be canceled, however, because the facilities were required for career gunners.* By early 1943 gunnery school capacity had been expanded so that the flow of navigation trainees to gunnery schools could be stabilized, and by the middle of 1944 gunnery instruction was provided for all students before their entry into navigation schools.[73]

Before April 1943 special instruction had been limited to fifteen weeks, but at that time an eighteen-week curriculum was placed in effect. Another two weeks were added in December 1944.[74] The directive establishing the program of April 1943 was the first to prescribe uniform instruction in all navigation schools, including the Pan American contract school. The stated objective of navigation training was to qualify students as precision dead-reckoning navigators with basic proficiency in pilotage, radio, and celestial navigation. Dead reckoning was a method of navigation which involved charting a given course, noting the required directional bearings, and computing the airplane headings and airspeeds necessary to fly the charted course. Pilotage involved holding a course by following approximate compass headings while observing certain terrain features used as checkpoints. Radio navigation depended upon signals received from selected ground stations, while celestial navigation was the technique of holding to a course by reference to the stars. To insure the greatest possible accuracy, the navigator was trained to use all available information.[75]

The overwhelming proportion of training time was given to

* For this term, see below, p. 590.

ground instruction, with some 500 hours devoted to teaching the several methods of navigation. Theory was reduced to a minimum in the effort to teach the cadets how to do a job and do it well. Students were first introduced to the basic principles of navigation and were then taught to use the fundamental tools: the compass, drift-meter, altimeter, plotting sheet, logbook, and other devices. Problems were then presented for solution. In the final stage of ground instruction the cadet participated in flights, with critiques of his performance as navigator. Instruction on weather and instrument calibration, together with standard aircrew military and physical indoctrination, rounded out the ground program.[76] Air training was carried on concurrently with ground instruction, beginning usually in the fourth week of the course. Some 20 navigational flights were scheduled, adding up to a total of approximately 100 hours. Rendezvous, search, and patrol problems, in addition to straight flights, were included in missions flown by night as well as day. Each plane normally carried three trainees, their instructor, and the pilot. One student navigated to direct the pilot, as a regular navigator would do; the other two usually followed the pilot, recording on their charts the actual course being covered. Upon completion of a flight, the planned course of the first navigator was then checked against the recorded course. Each of the three students rotated into the position of first navigator on succeeding flights. Experience showed a close correlation between the ground and air performances of navigation trainees, although some students proved unable to adapt to air conditions.[77]

Probably no other aircrew program was started with so few qualified instructors, and the shortage lasted longer than in other programs. The demands of the operational air units for navigators far exceeded the supply of qualified specialists during the first year of war; as a result, practically no experienced personnel could be spared for teaching, and reliance had to be placed upon new graduates of the navigation schools. Though not classed as instructors, pilots assigned to fly the planes used in navigation training were important for its success, and there was also a serious shortage of this type of personnel—a shortage aggravated by the policy of rotating such pilots, as well as navigation instructors, to combat organizations.[78] The several schools provided their own indoctrination of teachers until late in 1943. At that time a central instructors school (navigator) was established at Mather Field in California. Soon trans-

ferred to Selman Field in Louisiana, this school served not only to supply needed instructors but to help in standardizing the methods of instruction.[79]

The AAF failed to provide standard textbooks, syllabi, and training aids until mid-1944. Before that time the individual schools supplied students with a variety of materials. Maps and charts of all types were procured from standard sources; reference handbooks for navigators were prepared by the instructors themselves. In June 1944 a standard work, the Air Navigation Textbook, a comprehensive and satisfactory manual, was produced for distribution to the schools. Numerous films on navigation were made available, large-scale mock-ups of the navigator compartments of medium and heavy bombers were fabricated, and instruments and instrument mock-ups were widely used as training aids.[80] Various types of synthetic trainers were tried as a means of simulating navigation flights, but none of these proved very successful; the first to be obtained in considerable numbers was the G-2 dead-reckoning trainer. It was built like the navigation compartment of an airplane, was similarly equipped, and was mounted on rollers. A number of these devices were usually installed in one room. The G-2 instrument readings for airspeed, altitude, wind direction, and other factors affecting navigation could be changed at will by the instructor from a control desk. The students, who operated the electrically driven trainers, noted the changing instrument data and set courses for the G-2's to follow across the floor of the room. By the time these trainers could be distributed in sufficient numbers, the supply of aircraft at the navigation schools had become adequate, and the need for substitute devices accordingly declined. The G-2 trainer, furthermore, was unduly complex for practical purposes.[81]

A variety of airplanes were used during the early months, but the Beech AT-7 became the standard trainer after the middle of 1942. The principal shortcoming of the AT-7 was its limited passenger capacity and the lack of sufficient range for long navigation missions; during 1945 a number of C-47's, the work horses of the AAF, were converted for use on long flights. After V-J Day it was recommended that four-engine planes, preferably C-54's, be substituted for the C-47's then in use at navigation schools.[82] Until 1945 it continued to be difficult to get the navigational instruments needed for proper instruction of cadets. The competition between the requirements of combat units and the needs of the schools became espe-

cially acute in the recently developed items in a field marked by rapid technological progress. It was often necessary to train the navigator without the equipment he would use upon assignment to a combat unit.[83]

Early in 1942, in accordance with a growing emphasis on heavy bombardment and with the demands of operational commitments that were literally global in their extent, the AAF revised upward its previous estimates of requirements for navigators. The training program was expanded still more rapidly in 1943, and in late 1944 the monthly number of cadets receiving navigation instruction reached a peak of over 2,500. By V-J Day more than 50,000 students had graduated from the specialized navigation schools.[84]

Since mathematical ability was one of the most important qualifications of a successful navigator, in determining navigator stanines the heaviest weight was assigned to the scores on arithmetical reasoning, dial and table reading, and general reading comprehension. Only those students with the highest scores in these areas had a good chance of completing their training successfully, so that their selection became more restrictive than that for either pilots or bombardiers. Although fewer young men desired navigation training than pilot training, no special difficulty was experienced after 1942 in procuring a sufficient number of qualified candidates. The morale of these students was in general good, and many of them looked forward to using their training after the war as navigators for civilian airlines.[85]

The chief reason for failure of students in the navigation schools was inability to meet basic proficiency requirements on air missions. The trainee had to demonstrate his ability to navigate by day within a course error of 1½ degrees and a time error of 1½ minutes per hour of flight; he had to navigate during darkness by celestial means, over distances up to the full range of the training aircraft, to within fifteen miles of his objective. The average rate of attrition in specialized navigator training was approximately 20 per cent.[86]

Flexible Gunnery Training

Every member of the combat crew had a vital responsibility in executing the aircraft's mission. When a bomber was under attack by hostile fighters, it was the aerial gunner who defended the lives of his teammates; on the skill he had developed rested the fate of the crew.

The difficulties in flexible gunnery training were greater than

those for any other flying specialty. As in the navigation program, the Air Corps had virtually no background of experience in this type of instruction. Equipment shortages were extreme, and the problem of procuring qualified instructors unusually serious. Finally, it was several years before an adequate sighting and firing system was evolved, and a practicable means of simulating actual combat firing was not developed before the end of the war. As a result, the performance of flexible gunners in battle was not so efficient as desired, and the training program was a subject for continual criticism and controversy.[87]

Although plans had been under consideration for some time before Pearl Harbor, no specialized school for flexible gunnery was in operation when the United States entered the war. Construction was being completed, however, at Las Vegas Army Air Field, Nevada; Harlingen Army Air Field, Texas; and Tyndall Field, Florida. Students were assigned at once to these fields for instruction with whatever equipment was available. Construction at other sites was soon begun, and by the middle of 1944, when the number of students in training reached its highest point, seven specialized gunnery schools were functioning.[88]

Men entered the gunnery program from a variety of military backgrounds, and the basis for selection was continually changing. Until December 1942 training was open only to volunteers, but after that time certain categories of specialists were automatically eligible for selection. All of the enlisted members of bombardment crews were required to have flexible gunnery training; some were designated career gunners and had no other specialty, but for most of the crew members—armorers, airplane mechanics, radio operator mechanics, or other specialists—gunnery was a secondary specialty. Of the officer members of the bombardment crew, only the pilot and co-pilot were exempt from gunnery instruction; the navigator and bombardier were given the training when facilities permitted.[89]

The total number of officers and men who graduated from gunnery schools—more than 297,000 during the war period—was larger than that for any other Air Corps specialty except aircraft maintenance. Physical qualifications for admission were successively modified; the age limit was raised to 35 years, height to 6 feet, and weight to 180 pounds. Officers attending the gunnery schools received training in whatever grade they held upon entrance, but the policy

regarding enlisted men varied. Beginning in 1943 graduates who had previously completed a course of specialized technical training were awarded the grade of sergeant; those who had not were made privates first class and were promoted to sergeant upon completing a technical specialty. The morale of gunnery students was frequently poor. Attempts to induce volunteers through widespread publicity campaigns brought in many men who did not understand the nature of the training and the real demands of the position. During the course of the transition from the voluntary to a selective system for student procurement, many men were resentful when assigned to gunnery instruction. A considerable number of these involuntary trainees proved unable to perform their duties satisfactorily, while others requested elimination on the grounds of fear of flying. Elimination rates for all causes varied considerably as a result of changing methods of student procurement, relaxation of physical standards, and lack of a standardized instructional program. The rate for each class ranged from under 1 per cent to nearly 20 per cent; the average per class was less than 10 per cent.[90]

The standard gunnery course* as developed by the year 1944 consisted of six weeks of familiarization with equipment, ground firing, and air training, as well as the usual military and physical training.[91] Familiarization, which required about 125 instructional hours, introduced the student to machine guns, turrets, and sighting procedures. Although various weapons were studied from time to time, machine-gun instruction was concentrated upon the .50-caliber aircraft model, which became standard equipment on American bombers and which the students were required to strip and reassemble while blindfolded. Instruction was given also in the maintenance and manipulation of turrets, but shortages of the proper types were a persistent handicap. Beginning in 1943 the schools evaded this problem by adopting a policy of specialized training on certain types of turrets. Instruction in sighting procedures went through more changes than any other phase of gunnery indoctrination. During 1942 the student had to become familiar with as many as ten different kinds of sights. Various methods were employed for estimating range and lead in

* All except the career gunners received training in radio, armament, maintenance, or some other specialty in the AAF technical schools. Since this training was identical with that given to the corresponding ground technicians, it need not be described here. A discussion of training in the technical specialties is presented below, pp. 629 ff.

deflection shooting, but they were generally too complicated. The use of tracer ammunition as a partial substitute for ordinary sighting methods was tried out experimentally. It was discovered, however, that observation of tracer trails often gave an erroneous impression of the true course of the bullets, and the tracer method did not gain wide acceptance. In October 1943 the schools adopted the position firing sighting system, a method adapted from but considered more accurate than the British zone system. Basically, the system involved aiming behind the attacker, instead of in front of him, as was true in deflection shooting, in order to compensate for the effect on the bullets of a bomber's own forward motion. In 1944 automatic compensating and computing sights were replacing the old iron ring and the newer optical ring sights. The automatic devices mechanically calculated proper allowances and made it necessary for the gunner merely to keep the enemy plane in his gunsight. The compensating sight was the one most generally used during 1945.

Synthetic trainers were employed from the beginning to teach turret manipulation and sighting. The simplest of these trainers was a device consisting of a hand-operated spotlight and a large concave surface. While an instructor moved the spot of light across the surface through patterns such as ovals and figure 8's, the student practiced tracking, framing, and triggering from his turret-mounted machine gun. A more elaborate device, originally called the "Jam-Handy," had two motion-picture projectors. The student, seated behind a mock machine gun, observed pictures projected on a wall by one of the machines. Actual combat films were shown, including fighter approaches, attacks, and breakaways as photographed from a bomber. The student estimated the range of approaching aircraft, as shown by the film, and "fired" at 600 yards. The film's sound track gave the noise of gunfire if the target was in range; if not, a continuous bell. The second projector was synchronized with the first so as to cast a spotlight on the wall which showed the correct point of aim to hit the target. The spotlight could be turned on at will, and the student could see whether he was aiming at the proper point. Other devices, even more elaborate and more difficult to maintain, were in limited use. They proved fairly successful so long as the equipment functioned properly and good films, showing the latest combat maneuvers, could be obtained.[92]

Actual firing on the ground supplemented the manipulation of

weapons and synthetic trainer exercises. Many varieties of ranges were constructed, including the B-B gun ranges for .22-caliber rifles or machine guns. In the moving-base range, especially popular with students, several trucks equipped with turrets proceeded at intervals around a track, the wheels of the trucks deflecting wires which set off traps. The students fired at the targets as they were thrown up at various angles from the traps. Another popular type was the moving-target range. This varied in form but generally involved the use of a driverless jeep on a fixed track, carrying targets on high poles. The jeeps themselves were hidden by a revetment while the students fired at the targets from pedestal-mounted machine guns. Some sixty-five hours were assigned to ground range exercises of all types.[93]

From the beginning of flexible gunnery training, air-to-air firing was considered essential and was included in all the curricula. But the types of aircraft at first available were ill suited to the purpose. Various types of trainers and combat aircraft were employed; the Lockheed AT-18, equipped with Martin turrets, proved the most successful until B-17's and B-24's could be obtained. Targets, usually of the sleeve or flag type, were towed by a variety of utility aircraft. In 1944 it was prescribed that air training consist of twelve two-hour missions. Performance of at least six missions was a requirement for graduation. The basic criticism of conventional firing exercises, up to the year 1944, was that they did not simulate actual attacks by fighters against bombers. Students who fired from an airplane at a target towed by a plane on a more or less parallel course were doing something which would hardly be repeated in a combat situation. What was needed was a practicable means of firing, or simulated firing, against fighter planes as they executed typical combat attacks. The best answer to the problem seemed to be the camera gun, which came into general use during 1944 and 1945. A special type of motion-picture camera was installed in turrets on bombardment airplanes, and students "fired" these "guns" as fighter-type planes flew normal pursuit curves toward the bombers. While the theory of the camera gun was generally lauded, practical difficulties arose in procuring and developing the film and in assessing the results for each student. By July 1945 nose cone attacks by fighters were included in camera-gun missions in addition to the established beam and stern approaches.[94]

A method of training even more realistic than the camera gun was introduced in February 1945. This was the frangible-bullet method, the product of experiments which had begun in June 1942. The frangible bullet, made of a combination of lead and plastic, splattered into powder when it struck the target. Specially built planes, Bell RP-63's protected by armor plate, made conventional fighter attacks against bombers, while gunner trainees fired frangible ammunition against them. The RP-63's were equipped with radiosonic devices which registered hits on a meter in the pilot's compartment and at the same time flashed a wing lamp to show the gunners that they had scored. Although the schools were enthusiastic about the realism of the frangible-bullet exercises, numerous difficulties prevented their general adoption before the end of the war. Frangible bullets had only one-third the powder, two-thirds the weight, and one-half the speed of regular bullets; these ballistic differences necessitated special adjustment of gunsights. Excessive quantities of carbon accumulated in the guns while firing frangible ammunition, causing frequent malfunctions. Furthermore, the RP-63's were pierced by bullets which struck inadequately armored surfaces, and the coolant radiators were damaged by particles of bullets entering the airscoops. In view of the desirability of the frangible-bullet project in principle, strenuous efforts were made to overcome these practical limitations.[95]

Almost all of the instruction at gunnery schools was performed by enlisted men retained for the purpose from each class of new graduates. The selection was at first more or less arbitrary, but later the desires and ability of the men were considered. The greatest single problem affecting the instructors' morale was their low rank; during 1942 the majority were privates or corporals. In the following years most instructors reached the grade of sergeant, but the problem of insufficient rank persisted throughout the war. There were two basic systems of instruction in flexible gunnery, the flight and specialist methods. In the former, one teacher took charge of a small flight of students and carried it through all phases of the course. In the specialist system the instructors concentrated on a specific subject, and students had a different instructor for each course. Practice varied at the several schools, although the Training Command in 1943 directed uniform acceptance of the specialist system.

Closely related to the problem of retaining proficient instructors

was that of obtaining satisfactory pilots. Pilots generally preferred combat work or instructing in pilot schools to gunnery assignments, and the better pilots were usually given their preference. The gunnery schools, consequently, appeared to be dumping grounds for inferior pilots. Efforts were made to raise the morale and performance of these pilots by impressing upon them the importance of their function, but the results were only partly successful. The central school for flexible gunnery, which took final form at Laredo, Texas, not only indoctrinated teachers but became a focal point for research and development in the gunnery program. Various types of instructional courses were established, and the research and engineering divisions of the school turned their attention to solving the theoretical and practical problems which were obstacles to more efficient training.[96]

Of the various special programs provided by the Training Command schools, one of the most interesting was the B-29 gunnery course. Although difficulties in obtaining parts and equipment impeded training at first, by the spring of 1945 a satisfactory program was in operation. The original curriculum lasted twelve weeks, but experimentation with a six-week program showed that the shorter course accomplished equivalent results. A distinctive feature of the B-29 course was the system of training gunners in crews of five. Each team included an officer bombardier who acted as "gun captain" and operated the forward turret; a remote control turret mechanic gunner; two waist gunners, one of whom was an armorer and the other an electrical mechanic; and a tail gunner, who was not a technical school graduate. Since most of these individuals had previously received instruction in the standard flexible gunnery program, the B-29 course was in the nature of conversion training. In addition to refresher courses on weapons and auxiliary equipment, the curriculum included study of the B-29 central fire-control system, exercises on special B-29 ranges, and air training in the Superfortresses.[97]

Flight Engineer Training

The B-29 was the only bomber employed by the AAF during the war whose operation required a third pilot—a special member of the crew, known as the flight engineer, who controlled the plane's mechanical functioning while the regular pilot and co-pilot controlled the plane's direction and altitude. Seated before a complex

panel, just behind the co-pilot, the flight engineer observed his instruments and made necessary mechanical adjustments. By movements of the levers and switches on the panel he regulated electrical, hydraulic, fuel, lubrication, and oxygen systems, and detected and corrected malfunctions. He was also responsible for inspection of the operating systems before each flight and for computing cruise-control data.[98]

When instruction began in April 1943, only officer graduates of maintenance engineering courses and a small number of experienced mechanics were accepted. To meet the demand for greater numbers, engineering prerequisites were modified, but even so the supply of officer students was inadequate. Training was therefore opened to enlisted mechanics in March 1944, but these men were not selected carefully, and the number of properly qualified individuals in this category also proved insufficient. As an expedient, a plan was tried to utilize rated pilots in the flight engineer program. The results of this attempt were most discouraging, since the majority of pilots had little liking for the job. At last, early in 1945, the position of flight engineer was placed on the same basis as the position of pilot, bombardier, or navigator; aviation cadets and aviation students were enrolled in a program which led to the rating of flight engineer and commissioning as second lieutenant or appointment as flight officer. This arrangement was generally accepted as the most satisfactory method of flight engineer procurement. Of the students who entered from all categories, approximately 7,800 were graduated from advanced training. The elimination rate varied greatly, depending upon the qualifications of the different groups of students. In 1945 the over-all rate was about 9 per cent.[99]

Flight engineer instruction, following aircrew preflight school, was divided into a basic and an advanced stage. Upon completion of the course the graduates were normally assigned to a B-29 transition school, where they learned to fly the Superfortress as part of the pilot–co-pilot–flight engineer team; following this transition they entered full combat-crew training. The nineteen-week basic curriculum, as developed by May 1945, provided instruction in B-29 first and second echelon maintenance. It also included explanation of the flight characteristics of the airplane, routine and emergency flight procedures, engine operation, power settings, and fuel consumption. Eight of the instructional days were marked for actual flying. The basic course was taught at Amarillo Army Air Field,

Texas; advanced training was developed at Lowry Field, Colorado, but was later transferred to Hondo Army Air Field, Texas. The curriculum in 1945 was of ten weeks' duration and consisted of three principal phases. The mechanic-training phase emphasized inspections and correction of malfunctions in flight, as well as familiarization with emergency equipment and emergency control of the various operating systems. The cruise-control phase was considered to be the heart of the advanced curriculum. All of the factors affecting power output and fuel consumption, such as atmospheric conditions, speed, loading, and altitude were explained. Following this introduction, students were taught the use of cruise-control charts, which showed the fuel requirements of a mission when distance, altitude, and atmospheric conditions were known. Methods of correcting this estimate of fuel requirements for a variety of smaller determinants were then explained. The final phase of the advanced course consisted of four weeks of flights in which the students applied what they had learned about cruise control.[100]

Instructors for flight engineer training were obtained initially from a school operated by the Lockheed Aircraft Corporation for the commercial airlines. As the Air Corps' program expanded, the body of graduates became the chief source of instructors; most of the individuals retained as teachers were enlisted men. Shortage of equipment was the chief handicap to training before 1945; no B-29's were available at the flight engineer schools. Hence, B-24's were modified and used as improvised substitutes, several flight engineer stations including operating instrument panels being installed in each plane. To provide realistic practice in cruise control, the controls and instruments of all stations were interconnected, and several students could observe the effects while the instructor or a student manipulated the controls at any one of the stations. By 1944 adequate numbers of "weary" aircraft and one B-29 had been obtained for ground instructional purposes, but until 1945 lack of B-29 parts hampered the construction of mock-ups. Several flight engineer synthetic trainers were built by local station personnel, and at the end of the war the training aids available were considered excellent.[101]

Radar Observer Training

Training of radar specialists was one of the most important programs in the AAF. Instruction, which began just before Pearl Harbor, was changed almost continuously up to V-J Day. By Septem-

ber 1944 the program consisted of a large number of courses for radar mechanics and ground officers, described in the chapter on ground technicians and service personnel,* and several courses for flying radar observers. The most important of the flying specialists was the "radar observer-bombardment," who was trained to direct bombing through overcast (BTO). Three other types of radar observers were also trained for sea search, night fighter operations, and radar countermeasures.

Location of targets and bombing by electronic devices was one of the most significant developments in air war. BTO training was initiated in October 1943 at Boca Raton Army Air Field, Florida, and within a year it became the dominant course of the radar program. In September 1944 the course was restricted to pilots, but two months later the AAF decided to train bombardiers and navigators, rather than pilots, for BTO duties. Bombardiers were given a ten-week course in radar techniques, and navigators received the same training plus four weeks of nonradar bombing instruction. The radar phase of the course consisted mainly of instruction and practice in the operation of standard airborne radar equipment, such as the AN/APQ-13 (used in the Pacific) and the AN/APQ-15 (similar to equipment used in Europe). The chief obstacle to training was the shortage of radar-equipped aircraft. Despite this handicap, about 7,600 radar observers-bombardment were graduated from AAF schools during the war; they were assigned to heavy bomber or B-29 operational units. Heavy bomber lead crews each carried a BTO operator in addition to its regular personnel, while each B-29 crew included one radar observer-bombardment.[102]

Radar observer courses for sea search, night fighter operations, and radar countermeasures were also started in October 1943. Students for the sea-search program were selected from graduates of the standard radio-operator mechanic courses. The radar training for these men consisted of five weeks of practice in operation and first echelon maintenance of the electronic search devices, which they subsequently used on long-range patrol missions. Eliminated aviation cadets formed the source of trainees in the night fighter radar course. Over 1,000 of these students graduated from the nine-week course and received commissions or appointments. During training they

* See below, pp. 639–41.

were indoctrinated in the employment of airborne radar devices for detecting enemy bombers at night and directing the aim of the night fighter's guns against the unseen targets. Graduates of the standard officer communications course were selected for training in radar countermeasures; only about 500 officers were enrolled in this program, which required fifteen weeks of instruction. After completing the course, these men were assigned to special duty with operational units. On combat missions they flew with bomber formations and helped direct jamming of enemy ground detectors.[103]

CHAPTER 18

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COMBAT CREW AND UNIT TRAINING

SPECIALIZED instruction for pilots and other flying personnel was only the first step in a training program which had as its goal the provision of efficient combat units. Thus individual training led toward unit training, or what was commonly designated operational training in testimony to the emphasis placed on the teamwork so critical to the success of combat operations.

When the Air Corps began its great expansion program in 1939, no provision for operational training existed outside the combat groups themselves. Graduates of the flying schools were assigned either to fill existing combat units or to round out the cadre taken from an older unit to form a new one. Each unit was responsible for training its own personnel in order to meet proficiency standards set by training directives from the GHQ Air Force. The system was an old one and one well enough suited to the original need, but by 1941 it was becoming clear that some other plan would have to be adopted. By August of that year the number of authorized groups had risen from twenty-five in April 1939 to eighty-four. It would be some time yet before the groups actually organized would reach that number, but already the level of experience in all groups had declined sharply, with bad effect on operational training. Although there were other causes for the inefficacy of training, including a shortage of planes and of maintenance services, it was clear enough that the Air Corps could not plan indefinitely upon having enough cadres sufficiently experienced to guarantee prompt lifting of whole units to the desired level of proficiency.[1] With the coming of hostilities, not only were training objectives raised to new heights, but the demands of combat threatened so serious a drain upon experienced personnel as to cripple operational training under the existing system.

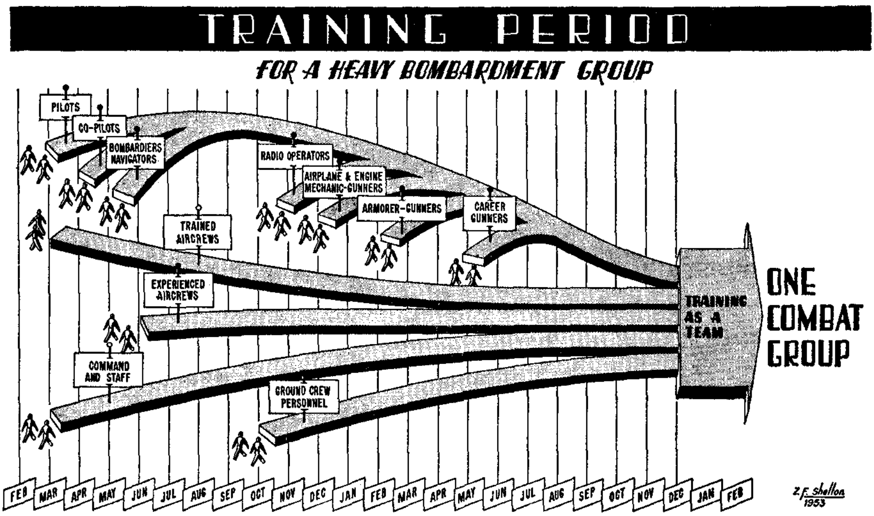
The OTU-RTU System

As early as April 1941 an American military observer in Great Britain had reported to the OCAC Training and Operations Division on the merits of the RAF operational training system.[2] Upon completion of individual instruction, British flying students were assigned to an operational training unit (OTU), where they received eight to twelve weeks of intensive instruction as a team on the type of equipment they were to use in combat. This RAF system was the inspiration for proposals made soon after the United States entered the war, among others by Brig. Gen. Follett Bradley, then head of III Bomber Command. He suggested in January 1942 that an OTU system be established as one way of guaranteeing a proper division of experienced personnel between the requirements of training and those of combat. He feared that under the existing system the demands of combat theaters would be allowed to drain off so many of the older groups that a critical shortage of experienced personnel for the development of new units would arise. He therefore proposed, as an adaptation of the older system, that certain groups be designated parent groups, with authorized overstrength, who would provide cadres for newly activated or satellite groups and who would assume responsibility for their training. Graduates of the training schools would be used to bring the satellite groups to authorized strength and, in a constantly recurring pattern, to restore the parent group to its overstrength. His plan, in its essentials, was adopted in February 1942 to govern operational training in the Second and Third Air Forces; in May the system was extended to include the First and Fourth Air Forces.[3]

During 1942 it proved difficult to give this plan full effect. There were unforeseen emergency demands from combat theaters, demands which at times had to be met regardless of the cost to domestic programs. The supply of combat-type aircraft for a while remained uncertain, the uneven flow of individual training programs presented scheduling difficulties, and, withal, it took time and experience to work the "bugs" out of the experiment. By early 1943, however, the plan was in general operation, with results that justified the decision in its favor.

Normally, six months were required after the formation of a cadre to complete the organization and training of a new group. Operational training began officially on the day that the cadre was dropped

from the parent's overstrength to become the core of the new group. In 1942 the responsible air force provided such special instruction as might be necessary to acquaint key members of the cadre with the special obligations they were now to assume. Beginning in 1943, however, cadre leaders usually received this training through a thirty-day course of instruction at Orlando, Florida, in the AAF School of Applied Tactics (AAFSAT), which had been established partly for this purpose in November 1942.* The course there was divided into



an academic and a practical phase, with roughly half the time devoted to each. Cadres for medium and heavy bombardment units were enrolled in the Bombardment Department; fighter cadres in the Air Defense Department; and light bombardment cadres in the Air Support Department. Through lectures and conferences group leaders reviewed under expert guidance the problems of command, intelligence, and operations in the context appropriate to the mission of their group. After completing the academic part of the program, the cadre was assigned to an AAFSAT base for operational exercises. With the assistance of complements provided by the air base's squadrons, the cadre spent about fifty hours flying simulated combat missions. This practical experience proved of great value in preparing

* For a fuller discussion of this establishment, see below, pp. 684–93.

the cadres for their new responsibilities, but close coordination of the academic and practical phases was not always accomplished, and at times the program suffered from lack of needed equipment.[4]

On returning to their assigned OTU stations, the cadres began training with their units, which by this time had usually reached regulation strength. The instruction for the group was divided in varying proportions between individual and team activities; during the final phase, both air and ground echelons functioned as nearly as possible as a self-contained combat unit. In the early months of the war, when OTU schedules were frequently interrupted, training was often less than satisfactory, but as time went on, the system became increasingly effective in preparing combat groups for action.

While the OTU system was evolving as the most suitable means of training new groups for combat, a plan calling for the establishment of replacement training units (RTU) as a regular means of providing replacement crews and crew members was also being developed. Until May 1942, when the RTU system was ordered into effect in the continental air forces, replacements for overseas units were procured by withdrawing qualified personnel from regular units stationed in the United States. This method, though simple, followed no orderly plan and jeopardized effective unit training by removing experienced personnel from U.S.-based groups. In order to establish a sounder method of providing combat replacements, AAF Headquarters directed that certain additional groups be listed as training organizations and maintained at an authorized overstrength to serve as reservoirs from which trained individuals and crews could be withdrawn for overseas shipment. In other instances, certain units were assigned a role similar to that of a parent OTU group. They gave instruction to combat crews and supervised their formation into provisional groups, which upon completion of training were liquidated to make their individual leaders and crews available for assignment as replacements to combat units. As was true of the OTU system, many months were required to place the RTU plan into full operation. By the end of 1943, however, when the formation of new groups (except for B-29 units) was virtually completed, RTU operations had become the major activity of the continental air forces. After 1943 the training organization was modified by the merging of personnel from each

fixed RTU group with its air base complement; the resultant unit was designated a combat crew training school or station (CCTS).[5]

The RTU system was simpler than the OTU and necessitated few important changes from the traditional organization and administration of combat units. Men designated as replacements were sent to an RTU group (or CCTS), where they received a similar though shorter course than that given in an OTU. Considerably less time was given to integrated activities at the group level, because the trainees of an RTU would not function as a group in combat. As they completed the required phases of training, individuals and crews were drawn from the RTU to serve in established outfits overseas.[6]

The types of OTU and RTU activities conducted by each of the continental air forces varied from time to time according to the needs of the war. In the beginning, certain of those forces were directed to produce certain types of units to the exclusion of other types, but eventually both bomber and fighter training was assigned to each continental air force. This was done mainly because the facilities of all air forces were needed to turn out the large number of bombardment units required; it was done also to facilitate joint fighter and bomber exercises in the later stages of unit training. Throughout the war, however, the Second Air Force remained the principal center for developing heavy and very heavy bombardment groups. The responsibility of the First and Fourth Air Forces was chiefly the training of fighter units, while the Third Air Force directed light and medium bombardment, reconnaissance, and air support activities. The I Troop Carrier Command performed the special task of training units for air movement of troops and equipment.[7]

During most of the war, OTU-RTU operations were governed by AAF Headquarters through the domestic air forces and the I Troop Carrier Command. The principal staff agency concerned, after the reorganization of March 1943, was the office of the Assistant Chief of Air Staff, Training; its Unit Training Division had immediate supervision over OTU-RTU plans and operations. Under each of the air forces various subordinate commands, wings, and groups issued instructional directives and supervised OTU-RTU activities. Toward the end of the war, some duplication of effort within each air force was eliminated by restricting to the air force headquarters the issuance of training directives and by limiting the functions of intermediate commands to supervision and inspection.[8]

Bombardment and Fighter Training Programs

Since the heavy bomber was the backbone of the American air offensive, the training of crews and units to man the big planes became the primary task of the OTU-RTU system. The statistical record for the first year of the war is not available, but approximately 27,000 heavy bombardment crews were trained in the period from December 1942 to August 1945; slightly more than half of that number flew B-24's, the others, B-17's. During the same period, about 6,000 crews were trained for medium bombardment and only 1,600 for light bombardment. The B-29 program, which did not get under way until the fall of 1943, turned out approximately 2,350 crews.[9]

The requirements of bombardment crew instruction, as in all other AAF instructional programs, were laid down in published training standards. These standards, issued from Washington, were successors to the training directives which before the war had been published annually by the GHQ Air Force. Throughout the war the standards were continually modified in accordance with technical developments and combat experience, but the successive issues followed a definite pattern. Each standard made a general statement of the purpose of the particular instructional program referred to. The ideal of unit training, as specified in these directives, was to create "a closely knit, well organized team of highly trained specialists of both the air and ground echelons." Detailed statements, serving as measures for achievement of the goal, composed the largest portion of a directive; these details related to administrative and technical as well as tactical matters. Bombardment units were required, for example, to demonstrate ability to service and repair their aircraft under field conditions, to provide defense against chemical attack, and to carry out proper intelligence procedures.[10]

These training standards established requirements to be met at all levels of performance. Detailed lists prescribed the particular duties which each man had to be able to carry out, and if the individual was deficient in any respect, additional instruction had to be given—a requirement that often forced attention to a type of training not normally the function of the OTU or RTU. Crew members were to understand their responsibilities not only for their particular jobs but also to each other; they were to complete successful tests in sustained high-altitude flights, evasion exercises, and precision bombing runs. Units had to demonstrate their ability to take off, assemble, and land

together; to operate in the air under radio silence and through overcast; to fly all types of formations; and to execute simulated bombardment missions.

The Second Air Force, which conducted the major portion of heavy bombardment training, divided it into three principal phases. Until the end of 1943 each of the phases was usually given at a different base, but that arrangement was then abandoned in favor of giving the entire program at one OTU station. During the first phase, individual crew members received instruction in their specialties, particular attention being given to instrument and night flying exercises for pilots, cross-country tests for navigators, target runs for bombardiers, and air-to-air firing for gunners. During the second phase, teamwork of the combat crew was stressed: bombing, gunnery, and instrument flight missions were performed by full crews. The third phase aimed at developing effective unit operation, the goal of the entire program. It included extensive exercises in high-altitude formation flying, long-range navigation, target identification, and simulated combat missions. When heavy bombardment unit training was assigned to the other continental air forces in 1943, they adopted the Second Air Force's three-phase system of instruction. Medium and light bombardment training, which was conducted almost exclusively by the Third Air Force, was similarly divided.[11]

When the individual pilot, gunner, or other flying specialist arrived at the OTU or RTU station, his main concern was the character of his crew. The crew was the family circle of an air force; each member knew that long hours of work, play, anxiety, and danger would be shared. Naturally, each man hoped to be assigned to a crew in whose members he had confidence and with whom he would be congenial. The assignment process was almost entirely a matter of checking names from alphabetical rosters, but the men so assigned generally accepted each other and adjusted gradually to the mixture of backgrounds and temperaments. If trouble flared, reassignment of individuals could always be made. To each member of the crew a vital part of the operational training period was learning about the personalities, as well as the duties, of his crew mates.

Much OTU-RTU instruction was given on the ground—in classrooms, hangars, and on gunnery ranges. Air training was conducted chiefly through informal supervision of flight operations. An experienced navigator, for instance, would accompany a new team on a

practice mission. During the course of the trip he would observe the recently graduated navigator, check his techniques, and offer suggestions for improvement. At the conclusion of each mission the "instructor" would file a report on the progress of the "student." Informal teaching of this kind was the rule for other crew positions, too. Tactics involving the coördinated use of crews, or of larger elements, were often demonstrated by experienced crews before the new units attempted them. Teaching methods in the operational programs, both on the ground and in the air, were not strictly standardized.[12]

Although the organization and techniques of instruction were basically similar in all types of bombardment training, certain features were unique to the B-29 program. Since particular attention had to be given to the selection of personnel, the usual policy of filling operational units with recent graduates of AAF schools was set aside. Instead, pilots and other crew members were selected from those who had had extensive experience in the operation of multiengine aircraft. When procurement of men for the B-29 program started in the middle of 1943, the Air Transport Command was expected to be the principal source of pilots and navigators with the desired experience, but relatively few men were transferred from ATC to B-29 training. Instead, instructors in the four-engine schools of the Training Command were to constitute the chief reservoir of experienced and available pilots. The earliest call for B-29 pilots specified a minimum experience of 400 hours in flying four-engine airplanes, but it was found advisable by 1944 to raise the standard to 1,000 hours, a level that could not always be maintained. For the post of co-pilot recent graduates of transition schools were used, but the remaining crew members were usually men of considerable experience.[13]

Crew and unit training for the B-29 was a responsibility shared by AAF Headquarters and the Second Air Force,* which in the fall of 1944 transferred its obligation for pilot transition instruction to the Training Command in the interest of accelerating the production of B-29 units. The specialized training program began with a five-week curriculum, given prior to crew assignment, for pilots, co-pilots, and flight engineers for the purpose of emphasizing the close teamwork required of these three officers in the operation of a Superfortress. Teams put through this special transition were then assigned to

* For a discussion of early B-29 training, see Vol. V, 52–57.

Second Air Force units for integration into full crews. B-29 operational training was divided into the customary phases but took slightly longer than heavy bombardment training. It was governed by special AAF training standards, which placed increasing emphasis on high-altitude, long-range navigation missions and use of radar equipment.[14]

Operational training for fighter units followed the standard OTU-RTU pattern, but naturally differed from that of bombardment units. Only in night fighter planes did the combat crew consist of more than one member, and the overwhelming proportion of fighter pilots served in the single-seater day fighters. From December 1942 through August 1945 more than 35,000 day fighter pilots were trained, as contrasted with only 485 night fighter crews.[15] Since the problem of crew teamwork did not exist in day fighter training, the program was directed toward maximum individual proficiency and precise coordination among the pilots of each squadron and group.

The instruction prescribed for the individual pilot varied considerably during the war. Although the Training Command eventually gave some transition experience to pilots on combat fighter types, it was generally necessary for OTU's to give transition training on whatever aircraft might be available. Following such familiarization, the pilot was required to fly the aircraft in specified acrobatic, aerial bombing, and gunnery exercises, and in simulated individual combat. Navigation missions, instrument flying, and night flying were also prescribed. Stress was placed, especially after 1943, on high-altitude operations and on the development of combat vigilance and aggressiveness. Unit as well as individual instruction was limited by the pressure of time during the first part of the war. Within the hours available, the greatest attention was paid to take-off and assembly procedures, precision landings in quick succession, formation flying under varying conditions, and the execution of offensive and defensive tactics against air and surface forces. Along with these came instruction on how to maintain aircraft in the field, on procedures for movement to a new base, and on necessary administrative and housekeeping activities.

Night fighter training, though it had much in common with the standard program, differed in certain important ways. Instrument flying, night formation exercises, and night gunnery had to be stressed. Attention also had to be given to crew teamwork since the night

fighter was operated normally by a pilot, radio observer, and gunner. Unit tactics were on a smaller scale than for day fighters but were more complex and difficult. The basic operating unit was a squadron rather than a group; its mission was the interception and destruction of enemy bombers raiding by night.[16]

Experience in overseas theaters showed that separate AAF training was not fully satisfactory for operational needs. Since the AAF was frequently assigned missions that required cooperation with ground, naval, and antiaircraft units, it was obvious that training for such missions was necessary. Deficiencies in air-ground teamwork were strikingly revealed in the North African campaign, and steps were taken in 1943 to provide more effective combined training of air and ground forces. The I and II Air Support Commands were specifically directed to develop appropriate exercises in cooperation with surface units. Bombardment, fighter, and observation units, after completing their regular training, were assigned when possible to one of these commands for the desired combined training. Relatively few air groups participated in the program, however, because of the urgent demand for shipment overseas as soon as unit training was finished.[17] Joint exercises between air and antiaircraft units took the form chiefly of defense against simulated bombardment attacks, and involved the use of fighters, searchlight units, antiaircraft artillery, and aircraft warning systems. By the end of 1943 exercises of this kind were being conducted in the First, Third, and Fourth Air Forces.[18]

But even more important to the AAF than its cooperation with other elements of the armed forces was the success of its bombardment campaigns. It was not too long after its commitment to battle that the Eighth Air Force found that unescorted bombardment meant prohibitive losses. The need was for more training in fighter-bomber cooperation. Such exercises had been carried on to a limited degree before the war, but during the first year after Pearl Harbor they were dropped because of the lack of time. Early in 1943 the Second and Fourth Air Forces began to provide joint fighter-bomber training as part of defense maneuvers on the Pacific coast. These maneuvers, in which the Navy participated, were simulated attacks by carrier-launched aircraft on various coastal cities. Bomber units with fighter escort sought out the vessels and on the return flight provided targets for interception by fighter units.[19] Since reports from combat theaters continued to stress the need for better teamwork between

fighters and bombers on cooperative missions, and for more effective defensive action by bombers against hostile interceptors, the AAF undertook in the fall of 1943 to increase the amount of fighter-bomber training and to systematize the program in all the continental air forces. In order to provide a necessary basis for combined training in all of the domestic air forces, heavy bombardment OTU's were established in the First and Fourth Air Forces, which had formerly been restricted to fighter units, while fighter OTU's were activated in the Second Air Force, which had formerly been restricted to bombers. The Third Air Force was already engaged in both types of training on a scale sufficient to permit effective combined exercises.[20]

Basic proficiency requirements for combined training were outlined in an AAF training standard; the individual air forces prescribed more detailed requirements in the conduct of their respective programs. The Fourth Air Force, for example, directed that fighter pilots participate in at least one supervised interception and three attacks on bomber formations at an altitude of 20,000 feet or above. A minimum of one two-hour escort mission was called for, as well as exercises in cover protection for bombers engaged in taking off and landing. Each bombardment crew was to undergo at least six high-altitude fighter attacks and to fly with escort as often as practicable. Camera guns were employed by both fighters and bombers during these realistic maneuvers. Lack of sufficient time for joint training was the principal handicap; not until 1944 was enough time allowed for an effective program.[21]

Those charged with the administration of operational training programs faced three major problems during the war. One was the relationship between AAF Headquarters and the individual air forces responsible for execution of the various programs. Another was personnel. This was, indeed, a twofold problem: how to overcome the inadequate preparation of trainees and how to hold a minimum number of experienced instructors. The third problem, common to all training activities until the closing months of the war, was an insufficient supply of aircraft, equipment, and facilities.

The relationship between AAF Headquarters and the subordinate air forces was based on the announced principle that Washington would tell the lower commands what to do but not how to do it. While a good case could be made out for such a theoretical differentiation, there was no way in practice to draw a hard line between the "what" and the "how." The air forces frequently complained that the

principle was not being applied. In the summer of 1942, for example, the Second Air Force protested against interference from Washington in the problem of meeting unit-production requirements. It asserted that AAF Headquarters should specify only the number and types of units required and leave to the air force responsibility for determining which units would be trained and in what order. The Third Air Force likewise opposed directives which were so strict as to preclude the flexibility essential to an effective training program. The dispute was a natural one, arising from Washington's desire to insure the production of more or less standard units for overseas shipments, and from the conflicting need of the individual air forces for some discretion in working out their own special problems. The reorganization of AAF Headquarters in March 1943 clarified functions and helped to remove friction between Washington and the continental commands.* As the war progressed, the air forces complained less and less of interference with their prerogatives, and smoother command relationships gradually evolved.[22]

A more serious difficulty arose from the fact that through 1943 and even thereafter a majority of the individuals assigned to OTU's were short of the desired proficiency in their particular specialties. The OTU's were therefore compelled to give a disproportionate share of time to individual training at the expense of their primary function of unit training. The continental air forces pointed to this fact in numerous sharp reports to Washington, assigning the blame to the Flying Training Command which was responsible for most of the individual flight instruction in the AAF. The trouble was that the Flying Training Command, while expanding by leaps and bounds, had to produce trained specialists within impossible time limits. Higher authority repeatedly demanded specialists in such numbers and on such schedules as to leave no choice but to send forward men whose training was admittedly incomplete. Eventually, as demands of overseas theaters became less desperately urgent, it was possible to introduce more realistic schedules into the individual training program. Meantime, consultation and exchange of officers between the two programs helped gear individual instruction more closely to the requirements of OTU-RTU operations.[23]

The OTU system had been established in part as a means of retaining necessary staffs of experienced instructors for operational

* See above, pp. 42–44.

training. Parent groups were supposed not only to provide cadres for their satellites but to maintain a core of veteran instructors within the parent units. Unfortunately if inevitably, the demands of the combat theaters continued to conflict with the needs of a sound training program. This was true especially during 1942 and 1943, when sudden calls upon all of the continental air forces to supply qualified units or replacements over and above those graduating from training left no choice but to raid the parent groups. In some instances instruction of certain groups virtually came to a halt for the lack of teachers. By 1944 the difficulty of maintaining a high level of experience in the domestic air forces was greatly eased by the availability of substantial numbers of combat returnees.[24] The use of combat veterans as instructors, however, presented fresh problems, for the battle-wise veteran had his own ideas and they did not always conform with views shaped by a different outlook than his own.

Shortages of aircraft, equipment, and facilities handicapped training at almost every step, from the beginning of the war until nearly the end. The most vital shortage was of aircraft of the required type. In the competition for airplanes the continental air forces had a lower priority than the combat air forces and, in many instances, than the fighting allies of the United States. In January 1943, for example, Washington diverted a shipment of P-39's from the Fourth Air Force to the Russians. Although the move was undoubtedly justified by over-all strategy, it seriously threatened the fighter unit program in the Fourth Air Force.[25] Combat forces enjoyed a natural preference in the assignment of the new and latest types, with the result that the aircraft left to U.S.-based units tended to grow old and worn. When replacements became necessary, "war wearies" were often assigned. These tried but tired aircraft needed frequent repair, which further reduced the number in operational condition at a given time. Lack of experienced maintenance personnel aggravated the problem, but determined efforts, aided by the work of mobile training units, eventually succeeded in raising significantly the level of maintenance.[26]

Shortages of aircraft affected all types of fighter and bombardment operational training until late 1944, and in the B-29 program the shortage lasted to the very close of the war. The situation with reference to fighter training on P-38's was comparable. As more and more P-38 units were equipped for overseas movement and as the training program was expanded to provide still more groups, the number of

P-38's in the OTU's became less and less adequate. In order to receive the necessary hours of training, it became necessary for student pilots to do part of their flying in P-39's. At the end of 1943 students had to take up to sixty hours of instruction on the P-39 before they could fly the plane which they were to use in combat. The OTU's were unable to discard this expedient of mixed training, with its obvious disadvantages, until March 1945, when an adequate supply of P-38's was on hand.[27]

Less vital than the shortage of aircraft, though equally persistent, was the lack of sufficient equipment and supplies. The deficiencies were in items necessary for flying, such as oxygen equipment, and for ground training as well. Production of high-octane fuel fell short of the over-all demand during part of 1943 and 1944, and this forced a sharp curtailment of flying hours, especially at high altitude, in the continental air forces. The lack of adequate airfields also seriously handicapped operational training, especially during the early years of the war; both fighter and bomber groups often operated from airdromes too few and too small, or poorly located for a particular type of training. These problems, as well as a host of others which sprang from the unprecedented demands of World War II, were not fully solved until the final year of the conflict.[28]

The overseas air forces were quick to complain to Washington if the units they received did not measure up to required standards of proficiency. These complaints were natural enough, because the combat air forces desired to relieve themselves of all unnecessary training of newly received units. In the early period of the war the most common criticisms of fighter units were on their gunnery and high-altitude flying. In September 1942 the VIII Fighter Command reported from England that very few of the new pilots had received any air-to-air gunnery practice against high-speed targets or any practice at customary combat altitudes. Weaknesses were reported also in navigation, in the assembling and maneuvering of large formations, and in instrument flying. A more exceptional complaint came in from the Southwest Pacific, where the Fifth Air Force asserted that in one fighter group the pilots had flown only advanced trainers or obsolete pursuit types before shipment overseas—not one had flown the airplane assigned to the combat group.[29]

Deficiencies in gunnery and high-altitude experience were found in bombardment units also. A further criticism of bomber units was

that the crews often lacked the smooth coordination needed for locating and striking a target successfully. Additional complaints specified shortcomings in instrument and formation flying, and a failure of pilots to understand their command responsibilities with reference to other members of the crew. Such reports from theater commanders were confirmed by answers to questionnaires frequently given to crews when they arrived at their overseas destination. As late as 1943 a substantial number of flyers declared that they had received neither air-to-air gunnery practice nor high-altitude experience. Some stated further that much of their flying in OTU's had no training purpose and had served merely to build up a minimum total of hours in the air. When reports of such deficiencies reached Headquarters, AAF from overseas, the responsible continental air forces were directed to take immediate steps toward correcting these faults. As the war progressed, criticisms of both bombardment and fighter units became less severe. Although complaints persisted, they were generally restricted to minor points of training. The achievement of the domestic air forces is confirmed by the fact that after 1943 the period of preliminary training in a combat theater could be substantially reduced.[30]

The improvement of fighter and bombardment operational training was achieved by better teaching, by specialization according to the peculiar needs of the several theaters, and by lengthening the period of instruction. Assignment of combat returnees to parent groups, which began on a token scale late in 1942, linked training more closely with the requirements of actual air fighting. Some of these veterans were not suited to become instructors because of attitudes growing out of their war service, the narrowness of their experience, or their lack of teaching aptitude. But by 1944 satisfactory methods had been developed for the selection of returnees best suited for teaching. After a course in the appropriate Training Command instructor school, they brought to the training program the dual advantage of combat experience and systematic preparation for instruction.[31]

During the summer of 1943 the experiment was tried of using part of a flight echelon on leave in the United States from the South Pacific theater as the nucleus of a new unit being trained for that theater. The experiment proved so successful that it was decided to adopt the practice as an aid to greater specialization in operational training. At regular intervals thereafter a war-weary cadre was re-

turned to the United States, where, after a leave, it became the core of a new group destined for the same theater upon completion of training. By late 1944 the policy of training for specific theaters was made standard for all air forces. Certain basic phases of instruction were retained, but beyond that, each air force modified its training program to suit the needs of a designated area. Certain CCTS's of the Third Air Force, for example, were directed to prepare their crews exclusively for operations against Japan. Subjects and tactics related to the European theater were accordingly deleted, and full attention was given to the conditions and problems of the air war in the Pacific. Specialization on this basis made operational training more pointed and better satisfied the desires of the individual theater air forces.[32]

While fighter pilots during 1942 had usually received only about 40 hours of flying time in operational units, students in the same category received 60 to 80 hours by the end of 1943, and at the close of 1944 fighter replacements were flying more than 100 hours. There was a comparable increase in the amount of instructional time given to bombardment crews; this extension of training permitted a substantial improvement in all-around proficiency. The increase in hours was accompanied by a redistribution of emphasis among the various phases of instruction and the addition of some new phases in response to combat developments. Fighter units placed increasing stress on gunnery, instrument flying, navigation, and formation flying. As the war progressed, special attention was also given to offensive actions against surface targets, such as strafing, rocket firing, and skip bombing. Other fighter crews concentrated on long-range escort, while omitting the low-level offensive tactics. In the bombardment program as a whole there was growing emphasis upon gunnery, long navigation flights, high-altitude formation, and practice bombing. One of the most important developments toward the end of the war was the increasing use of radar equipment in heavy and very heavy bombardment training.[33]

Reconnaissance Training

In every theater of combat accurate and extensive aerial observation, especially through photography, proved essential to the success of air and surface forces. The advances in techniques were startling by comparison with the methods of World War I, and these technical developments were accompanied by radical changes in the concept

and organization of reconnaissance functions. While fighter and bombardment units were turned out during World War II according to patterns conceived in the 1930's, reconnaissance underwent a series of significant transformations. These were largely the result of groping and experimentation, but they led ultimately to a sound and workable plan for reconnaissance aviation.

Aerial reconnaissance in the First World War had been carried on chiefly by nonpilot observers who were carried in aircraft specifically designed for observation purposes. Since the principal function of observers was the control of artillery fire, their training was centered at Fort Sill, Oklahoma, under the general direction of the Field Artillery. After the war the Air Service took over responsibility for this type of training and centered it at Kelly and Brooks Fields in Texas. In 1940 a special school for observers (pilot and nonpilot) was established at Brooks Field; at first the curriculum stressed artillery missions, but general reconnaissance and aerial photography received increasing attention. Graduates of the course were assigned to observation units for operational training. Late in 1943, after the observation groups had been disbanded, the course at Brooks Field was terminated. Appropriate individual training was henceforth carried on within the various types of reconnaissance units.[34]

Just before Pearl Harbor, Air Corps reconnaissance aviation strength included, in addition to the old-type observation groups, several reconnaissance squadrons and a single photographic group. The observation units, equipped with light, slow aircraft, were used for short-range missions in cooperation with ground forces and were assigned to the air support commands of each air force. The reconnaissance squadrons, on the other hand, were each attached to a bombardment group and equipped with aircraft of the type assigned to the group. These squadrons were to serve primarily as the eyes of the unit and secondarily as bombardment organizations, but in April 1942 all such units were redesignated bombardment squadrons in anticipation of the assignment of photographic groups to the theaters.* The 1st Photographic Group had been created in June 1941 to expand photo-mapping activities in the AAF and to conduct long-range photo reconnaissance after the pattern developed by the British. Each of the four squadrons of the group was assigned to one of the continental air forces.[35]

* See Vol. I, 425.

Training activities in reconnaissance aviation were very limited during the first year of American participation in the war. The 1st Photographic Group found almost no opportunity for training because each of its squadrons was busily engaged in carrying out mapping missions for hemisphere defense. It was not until May 1942 that the 2d Photographic Group was established for the purpose of instructing new photographic crews. The reconnaissance squadrons, attached to bombardment groups, were soon absorbed by those units and could no longer serve as training agencies. As a result, the reconnaissance training in progress during 1942 was restricted almost entirely to the observation groups, and their instructional program proved less than satisfactory. The main difficulty was lack of appropriate aircraft. The old observation planes with which the groups were equipped were in nearly all cases too few in number and, more important, were obsolete. Not until the end of 1942 were the first combat aircraft (P-51's and B-25's) assigned to observation groups.[86]

The general development of the reconnaissance training programs, as well as the basic concept of reconnaissance functions, was strongly influenced by overseas experience. The American observation unit in the North African campaign of 1942 proved sadly ineffective. As a result of the manifest inadequacy of the old-type observation organization, AAF Headquarters proceeded during 1943 to reorganize observation activities on the lines of British tactical reconnaissance units, which had operated effectively in Africa. In contrast to the AAF observation group, comprising a mixture of medium or light bombers, liaison craft, and fighters, the RAF unit was composed entirely of its speediest fighters. After numerous conferences and deliberations, the British model of organization and tactics was adopted. Appropriate OTU-RTU training for production of the new tactical reconnaissance groups was instituted shortly thereafter at Key Field, Mississippi. Photo reconnaissance instruction was similarly affected by British experience. Although the AAF was familiar with the techniques of aerial photography before the war, it learned a great deal from British methods. The commanding officer at Peterson Field, Colorado, who was responsible for initiating the first photo reconnaissance OTU training in 1942, had spent several months in England studying RAF organization and procedures, and his experience there had considerable influence upon the content of the AAF instructional program. Plans and programs for weather reconnaissance units were

almost wholly the result of American action overseas. Operations in North Africa, as well as in the Pacific, had been hampered by inadequate reports of meteorological conditions. The need for this new type of reconnaissance, revealed by actual combat experience, brought forth a special weather program in 1944.[37]

With the abandonment of the old-type observation groups in 1943, a clearer and more encouraging picture of reconnaissance aviation emerged. The new-type tactical reconnaissance squadrons, equipped with modified fighter-type aircraft, carried out short-range missions for the purpose of adjusting artillery fire and of securing tactical information by visual or photographic means. Supplementing the work of the tactical reconnaissance squadrons were smaller liaison units, generally assigned to ground force elements, which conducted limited observation, transport, and miscellaneous air tasks. These liaison units were equipped with small, low-speed aircraft of the "grasshopper" type. Photo reconnaissance units, tracing their origin to the 1st Photographic Group, became increasingly important by 1943. Their mission was to provide the necessary photographs for planning, location of targets, combat mapping, and assessment of bomb damage. Various converted combat types were assigned to photo units, depending upon the nature of their missions; the airplane most generally used was the F-5, a modified P-38. The smallest of the important wartime reconnaissance programs, and the latest to develop, was weather reconnaissance. Training to provide units capable of long-range flights for the purpose of obtaining meteorological data began in the summer of 1944. Weather crews were trained on F-5's, as well as modified versions of the B-24 and B-25. The total number of reconnaissance crews of all kinds, trained from the beginning of 1943 until V-J Day, was approximately 2,000. More than half of the total consisted of photo reconnaissance crews, trained chiefly on the F-5, while some 800 pilots were trained for tactical reconnaissance on the F-6, a converted P-51. In addition to the total number of reconnaissance crews, over 500 liaison pilots were prepared for action during the same period.[38]

From 1943 until the close of the war reconnaissance operational training was concentrated in the Third Air Force. The OTU-RTU system was followed, as in the case of fighter and bombardment unit training, though it hardly became effective before the program was reduced to production of replacement crews. Individual and unit proficiency requirements were established in the usual manner by AAF

training standards. At war's end there were fourteen of these standards governing as many specialized forms of reconnaissance instruction.

Tactical reconnaissance pilots were required by the training standards to demonstrate navigational skill over land and water, as well as ability to fly on instruments and in all types of formations. They were called upon to perform nearly every defensive and offensive maneuver expected of fighter pilots and were required in addition to master the techniques of artillery adjustment and aerial photography. A specific training standard likewise prescribed the requirements for the related liaison units. The liaison pilot held an aviation rating restricting him to the operation of small, low-powered aircraft; he was usually the graduate of a special Training Command course, briefer than that for a standard pilot. As members of a unit, liaison pilots had to fly formations and execute desired missions in support of ground forces. These included such activities as limited reconnaissance, courier service, aerial wire laying, artillery adjustment, and air evacuation. Photo reconnaissance units, like tactical reconnaissance units, had to meet most of the standards for fighter or bombardment crews and were required in addition to perform all types of aerial photography. Weather reconnaissance crews were not expected to engage in combat, but they were required to show proficiency in all aspects of unit flying as well as in their technical specialties.[39]

The greatest single handicap to the reconnaissance program as a whole was the absence of a clearly formulated, stable concept of the function of reconnaissance aviation. The particular problems encountered, such as shortage of aircraft and personnel, stemmed largely from the fact that the program had not been properly planned and organized from the beginning. In the early months of the war the observation groups were considerably under authorized strength, and little improvement in the situation was brought about during 1942. This fact probably reflected the lack of confidence in observation aviation as organized at the time; at any rate the bombardment and fighter units were given higher priority in the assignment of graduates from the Flying Training Command. Specific examples illustrate the crippling and demoralizing effect of personnel shortages on the observation units. Inspection of the 68th Observation Group in April 1942 revealed that it had received no additional pilots since the summer of 1941 and, therefore, that no program of trainee indoctrination

was being conducted. Only 45 per cent of the authorized enlisted strength was assigned to the group at the time of the inspection. In October 1942 Headquarters, AAF reduced the strength of four observation groups of the II Air Support Command to half of their authorized allowance, so that personnel could be transferred to heavy bombardment OTU's and tow-target squadrons. Similar reductions in strength were made in other air support commands, in order to release crews for tasks carrying higher priorities.[40]

As a revitalized reconnaissance program developed after 1943, it gained increasing confidence and respect. With only a few exceptions, the newly organized units received their authorized personnel on schedule and began also to obtain a more satisfactory allocation of combat aircraft. Recognition of the importance of reconnaissance was underlined in June 1943 when AAF Headquarters assigned to the program an aircraft priority second only to that of heavy bombardment. As a result, instruction proceeded in the desired combat types with little interference from aircraft shortages.[41]

The duration of training in each of the various types of reconnaissance depended, as with the fighter and bombardment programs, upon the urgency of the demand for crews overseas and the amount of equipment available for instruction. In the early years the demand for personnel was exceedingly heavy, and supplies of aircraft, as already noted, were hopelessly deficient. The year 1943 proved to be the turning point. By early 1944 tactical and photo reconnaissance crews were receiving two months of operational training, and by September of that year it had become possible to extend the period to three months.[42]

The specific content of training courses, after being determined in accordance with the view of reconnaissance functions which evolved during 1942 and 1943, was continually modified in light of criticisms from overseas. Reconnaissance training enjoyed a special advantage over the fighter and bombardment programs, since close liaison, made possible by the relatively small numbers involved in each type of reconnaissance aviation, existed between overseas units and the domestic training establishments. This association became increasingly effective during the last two years of the war as veterans from the overseas units were returned as instructors to the home training bases.[43]

Photo reconnaissance training, while not radically changed as a result of overseas reports, was altered to meet important criticisms

during 1942 and 1943. Reported shortcomings of the photographic units included weakness in gunnery and instrument flying, insufficient training in photography and mapping, and inadequate knowledge of the mechanism and maintenance of reconnaissance aircraft. In response to these criticisms, the training units gave increased attention to the corresponding phases of the curriculum. In 1944 the number of instructional hours allotted to instrument flying and photography was substantially increased, each crew was for the first time required to complete a mapping mission at an altitude of over 20,000 feet, and an extended course in engineering was provided for pilots so that they would develop greater familiarity with the structure and maintenance of their planes.[44]

The tactical reconnaissance program, initiated after the abandonment of the observation groups in 1943, came under criticism as soon as the new units went into action. Deficiencies were reported in the same subjects as with the early photo reconnaissance groups: gunnery and instrument flying, photography, and knowledge of aircraft and maintenance. The tactical reconnaissance units were also criticized for their poor adjustment of artillery fire. In an effort to correct the principal weaknesses, the training organizations greatly extended the hours given to gunnery instruction and instrument flying. Increased time was likewise given to ground and air training in the direction of artillery fire. General readiness for combat was substantially improved during 1944 by the practice of sending RTU graduates to the 1st or 2d Tactical Air Division for additional training in combined maneuvers with ground force units in the United States. The three or four weeks of field experience was possible because the tactical reconnaissance program was producing pilots in excess of commitments; the proportion engaging in combined exercises grew steadily in the closing months of the war.[45]

Troop Carrier Training

Perhaps the most dramatic innovation in military tactics during World War II was the landing of airborne troops behind enemy lines. The American public was deeply impressed by the sight, in newsreels and photos, of skies filled with billowing parachutes as men fell earthward to encircle the enemy. The hardened paratrooper, with his peculiar gear, became a special kind of fighting hero, and his jumping cry, "Geronimo," became almost a byword. Airborne operations

were not unknown before the war. Experiments had been conducted during the 1930's by American forces, and striking demonstrations had been made by the Russians. It was the Germans who first introduced the technique effectively in World War II, but before the end of the conflict the United States was making the largest use of airborne troops. These comprised not only parachutists, but troops dropped in gliders or brought in by transports after landing fields had been secured.

While specially trained ground soldiers did the fighting after the landings, it was the responsibility of the AAF to make the deliveries of men and supplies. To carry out this responsibility was the mission of AAF troop carrier units, serving under theater or task force commanders in cooperation with ground force elements. The training of these units, which had to be able to perform all phases of airborne operations, was the function of I Troop Carrier Command. It was originally activated in April 1942, with the designation of Air Transport Command. Troop carrier headquarters was located throughout the war at Stout Field, Indianapolis, Indiana.[46]

The OTU-RTU system of operational training, used in the fighter and bombardment programs, was also adopted for troop carrier instruction. In the supervision of training I Troop Carrier Command was in a position coordinate with the four continental air forces; it was responsible directly to AAF Headquarters for meeting the training standards and requirements for troop carrier units. In April 1945 I Troop Carrier Command became one of the subordinate headquarters of the newly constituted Continental Air Forces.[47]

The task performed by I Troop Carrier Command, while quantitatively smaller than that of other domestic air forces, was nevertheless substantial. From December 1942 until August 1945 it produced more than 4,500 troop carrier crews; most of these were trained on the C-47 although in the last year of war a considerable number flew the larger C-46. In addition to the transport crews, which normally consisted of pilot, co-pilot, navigator, radio operator, and aerial engineer, some 5,000 glider pilots were prepared for their special function.[48]

The nature of troop carrier operational training is indicated by the successive training standards which were issued to govern the program. Individual crew members were expected to show proficiency in skills normally exercised by the corresponding specialists of bombard-

ment crews; proficiency in aerial gunnery was not required, however, because the troop transports carried no armament. Members of troop carrier crews, on the other hand, had special duties not required in other types of combat units. The pilot, for example, had to be capable of glider towing and to be familiar with the flight characteristics of gliders, while the aerial engineer had to know how to attach glider tow ropes and operate and maintain glider pickup equipment. The crew as a team was required to make accurate drops of aerial delivery containers, both free and parachuted, into small clearings surrounded by natural obstacles. Troop carrier squadrons and groups had to demonstrate skill in unit operations, including the transportation of paratroops, and the towing and releasing of loaded gliders in mass flights. Special curricula for the meeting of these standards were developed by I Troop Carrier Command.[49]

Following the period of operational training, or during the final portion of it, troop carrier units engaged in combined exercises with elements of the Airborne Command (Army Ground Forces). These realistic maneuvers, which lasted for about two months, were divided into three phases. The first consisted of small-scale operations in which a company of ground soldiers was transported. The scale of movement was increased in the second period, and during the final phase whole divisions were moved as units over distances up to 300 miles. In each stage of combined training the troop carrier groups placed emphasis upon single- and double-tow of gliders under combat conditions and upon night operations. Attention was given to all types of airborne assignments, including resupply and evacuation by air.[50]

Problems encountered in the development of the troop carrier program generally paralleled those in other types of operational training. These included personnel shortages, especially in the early part of the war, and inadequate preparation of many individuals assigned to the units. Securing qualified instructors was especially difficult, because before 1942 only a handful of men had had experience with troop carrier activities. Since the aircraft used were transports, experienced airline pilots were frequently employed as teachers during the early stages; their background, however, was obviously unequal to the demands of the curriculum. Qualified instructors were eventually assigned from AAFSAT, and these individuals were supplemented in 1944 by selected returnees from troop carrier units overseas. The principal equipment shortage was aircraft: as late as November 1943

the number of available C-47's was a limiting factor in the desired expansion of the program. By the middle of 1944, however, this supply bottleneck had been broken.[51]

One of the most difficult problems, unique to the troop carrier program, was that of training glider pilots. The principal trouble occurred in the individual training phase, which was the responsibility of the Flying Training Command, but the consequences were naturally felt by I Troop Carrier Command. Tentative planning for the production of glider pilots had been started as early as June 1941, but during the two following years the program was marred by hazy concepts of the training objective, conflicting ideas on instructional methods, and the lack of coordination between training quotas and the production of equipment. By 1943 a sound program had been worked out, but in the meantime there had been considerable waste of manpower, materiel, and morale. It was necessary in 1943 to reclassify 7,000 of some 10,000 trainees in pools awaiting glider instruction. Those students remaining in the program, many of whom were eliminees from other types of flying training, were given a one-month course of air and ground instruction on the standard CG-4A glider. Later the course was increased to eight weeks, with growing emphasis upon landing techniques.

By the end of 1944 it was decided to restrict glider instruction to rated power pilots, because they were available in sufficient numbers and could serve a dual purpose in troop carrier units. The former policy of glider-pilot selection had required, during most of the war period, a maximum amount of power flying experience, but the earlier trainees did not hold ratings which would qualify them to fly transport aircraft. Shortly after the decision to limit selection to power pilots, an experiment was conducted to test the necessity of the individual glider course for power pilots. When it was found that pilots not having the course adjusted easily to regular operational unit training, glider instruction in the Training Command was dropped. By 1945 the curriculum for glider pilots in troop carrier units included a transition phase on the CG-4A and an advanced phase requiring forty landings under full-load conditions. Pickup exercises were also required, as well as indoctrination in the important after-landing procedures.[52]

As with other operational training programs, instruction of troop carrier units was influenced by overseas criticisms. Most of the ad-

verse reports were received in the early years of the war before training started to function smoothly; I Troop Carrier Command used these reports as a guide for improving the preparation of units and crews. One of the most comprehensive criticisms was submitted in 1943 by the 374th Troop Carrier Group, engaged in operations in the Southwest Pacific. This overseas unit reported that new crews needed additional instruction in strange field landings, because landing strips in the island area were narrow and short and usually obstructed by trees or ridges. It was observed further that troop carrier crews were generally deficient in navigation by pilotage and dead reckoning, low-altitude flying, proper timing of drops, and mechanical knowledge of their aircraft. Early criticisms from the European theater pointed to similar weaknesses and stressed the lack of adequate training in night operations; glider pilots were reported as generally unsatisfactory. In response to criticisms of this nature, I Troop Carrier Command made continual changes in curricular emphasis, and in 1944 it took the broader step of introducing specialized theater training for its units. Since the theaters varied greatly in their demands upon airborne forces, this change made for greater efficiency in training. By late 1944 two of the troop carrier CCTS's were giving a generalized course while the other two gave specialized instruction for particular theaters.[53]

The foregoing description of operational training—fighter, bombardment, reconnaissance, and troop carrier—has been limited to air personnel. The flying combat crews could not have functioned, however, without the cooperation of ground crews within the units and of supporting maintenance and service organizations. The individual instruction of the host of mechanics and technicians and the molding of those individuals into effective crews and units will be described in the next chapter. It is convenient to describe here, however, one process that was common to air and ground personnel alike—the final preparation for deployment to a combat theater.

Preparation for Overseas Movement

The procedures for moving an air unit overseas were so complex that by 1943 more than four months were needed to ready it for shipment. The steps by which a unit reached its overseas station began in the Operations Division (OPD) of the War Department General Staff. On the basis of information provided by the AAF on units that

would be ready for shipment within a six-month period, OPD would request the AAF to prepare a specific type of organization for overseas assignment. At AAF Headquarters the Theater Commitments and Implementation Branch of AC/AS, Operations, Commitments, and Requirements was responsible for monitoring these requests. Normally it took approximately 120 days and 17 separate actions by Headquarters offices to move the unit to a port of embarkation (POE). The final movement orders came from The Adjutant General (TAG). These orders alerted the unit to await a call from the commander of the appropriate POE, who scheduled the shipment in accordance with a directive from the Deputy Chief of Staff and the availability of shipping. The call from the port commander might occur at any time within one to three weeks after receipt of the alerting orders.[54]

The Army's Transportation Corps, established on 31 July 1942, operated eight water POE's.[55] New York, the Army's largest POE, used two staging areas, Fort Dix and Camp Kilmer, both in New Jersey; the San Francisco and the Los Angeles POE's were served by staging areas at Camp Stoneman and Camp Anza, in California.* Many AAF units, including practically all ground and service personnel, underwent their final processing in these staging areas. Each of the POE's was a military command, with jurisdiction over the troops in its staging areas, and the port commander was made responsible for correcting any deficiencies in personnel, equipment, or training discovered during the staging process. In 1942 port commanders complained that AAF units were arriving undermanned and without having completed their basic military training. In response, AAF Headquarters directed in September 1942 that all units be completely manned before leaving their home stations, even if it was necessary to take experienced personnel from other units.[56] But training deficiencies continued until late in 1943.

In addition to the water POE's, the AAF used aerial POE's for those flying personnel who flew their own planes to combat theaters. Aircraft bound for the European theater via the northern route departed from La Guardia, Grenier, or Presque Isle Fields; when flying the southern route, from Morrison Field, Florida; and if flying to a Pacific theater, from either Hamilton or Fairfield-Suisun Fields, Cali-

* Other POE's were located at Boston, Hampton Roads, Charleston, New Orleans, and Seattle.

fornia.[57] General Arnold parried all attempts by the Chief of Transportation to assume the direction of aerial POE's (they had been assigned to the AAF on 1 July 1942) on the ground that the AAF had been charged with command and control over all air stations not assigned either to theaters of operations or to defense commands.[58] Control of the aerial POE's by the AAF, moreover, facilitated the final training and staging of air echelons.[59]

From mid-July to 5 December 1942 the AAF used the Foreign Service Concentration Command to deal with the special problems of overseas movement, but in December the final preparation of units for foreign service was restored to the four continental air forces. This action was accompanied by instructions that all units destined for overseas duty be carefully checked in accordance with a new inspection system, called Preparation for Overseas Movement (POM), which was under the supervision of the Air Inspector.[60] To prepare units for POM inspection, the AAF established by the fall of 1943 overseas replacement depots (ORD) at Greensboro, North Carolina, and at Kearns, Utah; in December 1944 a third ORD was opened at Santa Ana, California. It was anticipated that these ORD's would receive, process, and ship an average of 12,000 military personnel to POE's each month. They provided outbound personnel with final indoctrination, training and instruction, special clothing and equipment, and transportation to POE's. All basic training not previously completed by enlisted men had to be accomplished before shipment. The training program at ORD's, a continuation of instruction already received, included a refresher course in firing, and such "must" subjects as malaria control, first aid, censorship, sanitation, and chemical warfare. In addition, medical and dental checkups and inoculations were given.[61] Training schedules were planned for twenty-four days, though most essentials were completed in the first twelve, after which enlisted men were classified as ready for shipment.[62] Because there was a shortage of assigned instructors at the ORD's, it was necessary to train them from among available personnel. ORD's even got permission to use attached personnel as instructors, but this proved unsatisfactory.[63]

Officer processing at ORD's was less carefully supervised than that of enlisted men. At first an officer was made responsible for filling out a series of forms and visiting the various departments concerned with each phase of processing. Since this practice frequently resulted in

confusion, after 1 May 1944 ORD's instituted an assembly-line processing system whereby officers could complete the operation in one building.[64]

The multiplicity of training organizations and the consequent difficulties of standardizing procedures made the job of the staging agencies a hectic one. After July 1943 more and more of their responsibilities were shifted to the Training Command, which was made responsible for checking on the training, medical and physical condition of the men, the briefing on the theater of combat, and the issuance of equipment and completion of the records of all personnel.[65] In January 1944 Lincoln Army Air Field, Nebraska, was made an AAF staging area. In August the Training Command set up a liaison staff and sent officers to the four continental air forces and to the Personnel Distribution Command to assist them in all matters concerning records, training, equipment, physical condition, and qualifications of personnel transferred between commands for combat training, overseas shipment, or other duty. Still later, in March 1945, the Training Command was directed to establish a Combat Crew Processing and Distribution Center at Lincoln Army Air Field. Weekly shipments were to be made to Lincoln in such volume that the total inflow from all five training commands would maintain a sufficient reserve for supplying indicated requirements to combat crew training stations (CCTS). The function of the center thus was to assemble and distribute combat crews to the appropriate CCTS, and to make a final review of both personnel and records.[66] The establishment of such an installation as that at Lincoln, since it gave the Training Command a double check on personnel being processed for combat crew assignments, eliminated much of the criticism previously voiced by other commands.

CHAPTER 19

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TRAINING OF GROUND TECHNICIANS AND SERVICE PERSONNEL

DURING the war the AAF required four technical specialists for every man who flew. The ratio of total ground personnel to flying personnel was nearly seven to one, and for every man actually committed to air combat there were sixteen individuals who served within the AAF on some noncombat assignment.[1] Individual training of technical specialists was the responsibility of the Technical Training Command (TTC) from its establishment in March 1941 until July 1943, when its successor, the Training Command, inherited the job. In addition, the Air Service Command provided individual training for many of the specialists required for its own activities,* and the four continental air forces found it necessary to operate schools for special training of personnel of other arms and services on assignment with the AAF (ASWAAF). In this last category, however, the men were frequently assigned to the branch of origin—for example, the Signal Corps or the Chemical Warfare Service—for individual training and return to the AAF. Unit training, and such combined training of combat and maintenance organizations as might be necessary, was conducted by the continental air forces or by the ASC.

In the early days of the Air Service, practically all enlisted technicians, whether or not they were concerned directly with the maintenance of aircraft, had been known as airplane mechanics. But as the work of technicians became more and more specialized, the term "airplane mechanic" was gradually restricted to men who maintained

* See above, pp. 505–8.

airframes, aircraft engines, and accessories integral to the plane; these accessories included such equipment as propellers, hydraulic and electrical systems, carburetors, and generators. Technicians who specialized in such equipment as armament, cameras, and radio devices—equipment not considered strictly as parts of the aircraft—came to be known by special names and were trained in separate programs. The primary responsibility for aircraft maintenance in the AAF during the war belonged to teams of enlisted mechanics, each team working under the direction of a noncommissioned officer called a crew chief. Before the war it had been customary for each pilot to supervise the maintenance of his own airplane, but after 1941 this responsibility was assumed by a nonflying squadron engineering officer. Maintenance activities in the squadron were limited to the first and second echelon, that is to say, to regular servicing of aircraft, routine inspections and adjustments, and minor repairs. For the more difficult jobs, including periodic overhauls, the squadron depended upon depots and subdepots serving the needs of more than one combat unit for what was officially designated third and fourth echelon maintenance.* Though the distinction between these several levels of service depended in no small part upon a difference in equipment, some of the depot work required more highly trained specialists.

During the year 1938–39 fewer than 900 men had been graduated from the basic mechanics course of the Air Corps Technical School at Chanute Field. Between July 1939 and August 1945 graduates of courses in maintenance given by or for the AAF totaled more than 700,000.[2] Although this number includes many who graduated from more than one course, it serves to suggest the staggering proportions of the maintenance training that had to be provided. In the earlier stages of this great expansion the AAF depended upon three major types of schools: its own technical schools for basic airplane and engine mechanics courses, and for some advanced training; civilian mechanics schools, which provided basic instruction as well as training in third and fourth echelon maintenance for depot specialists; and factory schools, which gave training on the equipment of particular manufacturers. When it became apparent in the spring of 1943 that the initial demand for mechanics was nearly satisfied and

* See above, p. 388*n*.

that casualties among ground crews were proving extremely light, the number of trainees was drastically curtailed. Accordingly, after June 1943 students were no longer entered in civilian mechanics schools, and the number of factory schools and AAF technical schools was reduced.[3]

Individual Training in Aircraft Maintenance and Engineering

The basic airplane mechanics course, which trained men to perform first and second echelon maintenance, required thirty-eight weeks as taught before 1939. In order to accelerate training during the emergency period, the length of the course was progressively shortened; by July 1943 the standard course lasted 112 days, less than half the time required before 1939. After many variations, the course of training had by then become relatively stable. It included preliminary instruction in the use of tools, followed by practical study of airplane structures, operating systems, instruments, engines, and propellers. After the student had become familiar with the aircraft and its accessories, special attention was given to the procedure for engine changes, preflight and daily inspections, and the more thoroughgoing periodic inspections. Near the end of the course, about a week of maintenance practice and testing, under simulated field conditions, was required.[4]

Before the war all basic mechanic training had been general in character, but in the latter part of 1942 it was decided that the technical schools should concentrate their instruction upon particular airplanes. Thereafter, one school specialized on the B-17 and one on the B-24; others restricted themselves to aircraft of a certain type, such as medium bombers or transports. This arrangement promised a speedier provision of men skilled in their particular jobs, but experience demonstrated the need for a more flexible system. Accordingly, in October 1944 the curriculum was divided into a general course of seventy-six days and a specialized supplementary course of thirty-six days. The total training time remained unchanged, and the subjects taught were the same as in the single 112-day curriculum, but the new plan made it possible to provide specialized training on any airplane without the necessity of maintaining an extended course of instruction for each. It had the further advantage of permitting a man qualified on one aircraft to transition quickly to another type

by taking the appropriate short course. In May 1945 a basic maintenance course devoted exclusively to the B-29 was established. But otherwise the policy adopted in 1944 remained in force to the end of the war.[5]

Beginning early in 1942 it became general policy to send basic mechanic graduates to factory schools for additional instruction. When the graduates had received only generalized training in their basic course, the factories provided specialization on the airplanes produced by the particular manufacturer. After the basic mechanics schools began to specialize, the factories continued to supplement their work by giving training on aircraft which were omitted from regular AAF courses and by advanced instruction on the others. Although most of the factory training was on the level of first and second echelon maintenance, some third echelon work was included in the engine courses. Manufacturers of aircraft accessories, such as instruments, also provided advanced training, usually including fourth echelon work, on particular items of equipment. The chief problems in factory training were the need for coordination of factory curricula with those of AAF schools and the differences in maintenance techniques between factory personnel and AAF maintenance experts. In most cases these differences were easily ironed out.[6]

In addition to advanced training in general aircraft maintenance, the AAF provided a number of specialized mechanics courses. The electrical course, for example, prepared students to maintain aircraft electrical systems through third echelon repair. It required sixty days and included a review of elementary electrical theory and practice as a preliminary to the study of generator and starter systems; auxiliary electrical units, such as lighting circuits and warning systems; electronic turbosupercharger control systems; and ignition systems. The final phase of this course included practical maintenance problems and electrical system inspections.[7]

The instrument course trained men in first, second, and third echelon maintenance. The training period was extended from forty to sixty-six days as the variety and complexity of aircraft instruments increased. By 1944 the first phase of the course included constructional features, operating principles, and methods of making minor repairs on mechanically operated instruments, such as the altimeter, vertical and airspeed indicators, tachometer, and optical de-

vices. Electrically operated instruments, including the thermometer and fuel-mixture indicators, were taught in the second phase; and gyro-operated equipment, such as the artificial horizon and the automatic pilot, were given in a third phase. The complicated flux-gate compass was treated as a separate phase of instruction. Short subcourses, each one limited to a specific kind of equipment, were offered to mechanics who did not need training in the complete instrument course. This provision was common to the various programs of specialized maintenance during the war.[8]

Instruction in airplane hydraulic systems started in the summer of 1943 and was of forty-two days' duration. As reorganized in 1944 the course embraced three phases: familiarization with hydraulic principles and appropriate AAF technical orders; operation and maintenance of the hydraulic systems of fighter- and attack-type aircraft; and operation and maintenance of hydraulic systems of bombardment types. Instruction was conducted chiefly through work projects, such as removal, disassembly, cleaning, repairing, and reinstalling of hydraulically operated units. Training in propeller maintenance, which required about forty days, was conducted as a separate advanced program. This program was divided into four subcourses, one for each major type of propeller used by the AAF. Trainees were enrolled in those phases which met the needs of their service assignment. All instruction was centered around practical exercises performed in the shop.[9]

One of the most important of the advanced courses was the powerplant course, which aimed to develop engine specialists. By the fall of 1944 this training required seventy-two days. All work, together with brief oral explanations, was conducted in shops. It included maintenance, through the third echelon level, of standard radial and in-line airplane engines and their accessories, such as superchargers, carburetors, generators, and starters.[10]

Special advanced programs were established for new types of aircraft. Maintenance training on helicopters began in November 1944, when two courses were established. One covered first and second echelon procedures only and treated the principles of helicopter operation; the structures, controls, and assembly of the main and tail rotors; instruments; electrical system; power plant; power transmission; and inspection techniques. The second course carried maintenance through the fourth echelon. In the late spring of 1945 a

training course was started for maintenance of the newly developed, jet-propulsion P-80 airplane. The thirty-day curriculum stressed practical work in removal, installation, and repair of the various units and assemblies.[11]

Graduates of the advanced maintenance courses described above were normally qualified for third echelon work in base shops and subdepots. Other courses were required for the training of personnel to perform major overhauls in service depots. Since the Air Service Command had primary responsibility for this kind of maintenance, the training was in large part under its control. Some instruction was provided on the job in the depots themselves, but most of the trainees were assigned to civilian mechanics schools, with costs paid by the government. A jurisdictional conflict developed between the Air Service Command and the Technical Training Command over the schools outside the service depots; although the TTC won out in June 1942, the ASC continued to exercise varying degrees of control over the program through its right to prescribe standards for the schools. Both civilians and enlisted men were assigned to the civilian mechanics schools until June 1943, when the contracts were allowed to drop.[12]

While this depot program lasted, it consisted of two fifteen-week courses, one for airframes and one for airplane engines. Following an explanation of AAF maintenance systems and exercises in the use of tools, the student in the airframe curriculum studied the airplane's principal structural elements, including wing panels, control surfaces, tail assemblies, fuselage, and landing gear. Instruction was then given on such special features as the instrument and propeller systems. Procedures for complete engine change, as well as drill in the various periodic aircraft inspections, were also included in the course. In the airplane engine curriculum, the student studied the principles of internal-combustion engines and the construction and operation of air- and liquid-cooled airplane engines; he then received instruction in the disassembly and assembly of engines, on the fuel, oil, and electrical systems, and on procedures for inspection and change of engines.[13]

In addition to the standard basic and advanced maintenance courses, several auxiliary specialist programs were conducted. In one such program, aircraft machinists, sheet-metal workers, and welders received common instruction in the AAF maintenance system, in the

reading of blueprints, in mechanical and freehand drawing, in the use of hand, power, and measuring tools, and in heat treatment of metals used by the AAF. After this preliminary indoctrination, the machinist trainees were taught how to use lathes, shapers, drill presses, grinding machines, and similar equipment; sheet-metal trainees specialized in practicing aircraft repairs involving soldering, riveting, splicing, contouring, and related techniques; and students in training to become welders were taught both gas and electric welding, with particular attention to the welding of aircraft parts, such as oil and fuel tanks. Each of the courses in the metal specialist group required from 90 to 120 days of training. Toward the close of the war many combat returnees sought to enter these programs as a means of learning a trade for postwar employment.[14]

Various other auxiliary specialist courses were conducted by the AAF. Among these were programs for training parachute riggers and repairmen, and experts in the operation and maintenance of portable oxygen generators. Of unusual interest was the six-week arctic training course. Four weeks were devoted to operation and maintenance of various types of ground and airplane heaters and to the operation under arctic conditions of portable power plants, "snow buggies," and other equipment. Special attention was given to cold-weather lubrication, fuel-induction and electrical systems, and general maintenance of aircraft and engines in intensely cold weather. The final two weeks of the course were spent in actual frigid conditions; students lived in the open and learned how to construct emergency shelters, to travel in deep snow, and generally to protect themselves from the elements. This phase of the training was at first conducted at Camp Echo Lake, Colorado, high in the Rocky Mountains, but was later removed to Great Falls, Montana, which had a more severe climate.[15]

Most of the students in training to become engineering officers were enrolled as aviation cadets in a special twenty-three-week program. The course was taught at Chanute Field until December 1942, when it was transferred to Yale University; in August 1944 the program reverted to its original home. The purpose of the course was to qualify officers for over-all supervision of maintenance and engineering activities in a squadron or at a base. The students received thorough instruction in the subject matter of all phases of aircraft maintenance and related specialties, and combined this training with

military instruction appropriate to their future status as commissioned officers. In addition to the comprehensive course for cadets, a parallel course was offered to selected enlisted mechanics who, having completed the basic mechanics course, were put through the advanced course in about eight weeks; on its completion, these men were commissioned and sent to the six-week indoctrination course at the Officer Training School at Miami Beach. In August 1944 the courses for aviation cadets and selected enlisted mechanics were superseded by a program open only to pilots returned from combat. The curriculum was accordingly modified; maintenance fundamentals were omitted and cruise-control and test-pilot procedures were added. Advanced courses, open to men already qualified as maintenance engineering officers, were established early in 1945 for B-29 and other specializations.[16]

Some of the most effective maintenance instruction given during the war was conducted, not in schools or shops, but by mobile training units (MTU's). Since assigned mechanics, both in the United States and overseas, were unable to keep abreast of the frequent and sometimes radical modifications of aircraft, and since they could seldom be released for refresher training at fixed establishments, these mobile units, each of which was to give training in a particular type of aircraft, were designed to bring the school to the student. The MTU program was begun in July 1942, and although it developed slowly at first, by the end of the war twenty-four units were on duty outside the continental United States, five were en route overseas, twelve were being prepared for shipment, and more than a hundred were operating in the United States.[17]

The complement of an MTU varied in size from six to fifteen men, depending on the type of equipment carried. The liaison officer who headed the unit supervised the crew, determined the instructional needs of each organization visited, and established a curricular schedule appropriate to those needs. Another key member of an MTU was the crew chief, who supervised the work of the enlisted instructors; the instructors themselves were carefully selected and trained for this special assignment. In addition to the military personnel, most crews carried one or two civilian representatives of the manufacturers of the particular airplane or its accessories. These civilians, who returned frequently to the factory schools to learn

latest aircraft developments and maintenance techniques, were qualified to instruct in all phases of maintenance and repair.

This MTU program was so adaptable that an individual unit could give instruction varying in content from basic courses for inexperienced men to courses for experienced mechanics in improved maintenance techniques and in procedures for handling new equipment. Although serious difficulties arose in getting equipment for the first MTU's, the units eventually procured were models of efficiency. They contained tool kits, charts, motion-picture apparatus, and operational mock-ups of the principal aircraft assemblies and parts. By far the largest number of men to receive MTU training consisted of maintenance personnel, but aircrew members were also given instruction in order to encourage proper operation of aircraft and engines. The general reaction of all personnel to this form of training was highly favorable.

Individual Training in Communications

As communications equipment became increasingly specialized, the AAF found it necessary to establish more and more courses of training in the operation and maintenance of radio and radar devices. In 1944 some men were being trained solely as radio mechanics, some as radio operators, and still others as radio operator-mechanics (ROM's). A considerable number of the ROM's who met the physical requirements for combat flying were also given gunnery instruction and assigned to aircrews; the remainder performed their duties on the ground. In addition to the personnel undergoing basic radio training, a number of men received advanced instruction in the maintenance of equipment for ground-controlled radio interception, radio ranges, radio direction finding, and instrument landing. Another special course was given for control tower operators, and several programs were in effect for the training of nonflying air communications officers, who supervised maintenance and operation of radio equipment.[18]

Prior to late 1940 all radio training had been concentrated at Chanute Field, but when the Air Corps' expansion program got under way and it was decided to reserve the facilities of Chanute for airplane-mechanic instruction, radio training was transferred to Scott Field, Illinois. As the establishment of new radio schools became necessary to meet the rising demand for communications technicians,

administrative and instructional cadres were provided from Scott Field. The number of students and schools declined rapidly after 1944; the total number of graduates from radio courses given by AAF training commands during the period July 1939 to V-J Day was well over 200,000. In addition, the Air Service Command trained a considerable number of civilians in radio maintenance.[19]

The ROM course was the most important of the various communications programs. Students who demonstrated proficiency in either radio operation or maintenance, but failed in the other phase, were graduated as either radio mechanics or radio operators, but experience proved that it was better to train men in both phases than in one of the specialties alone. The ROM course in 1940 was of twenty-two weeks' duration; its objective was to train men to operate an aircraft radio station at a speed of sixteen words a minute and to perform first and second echelon maintenance of all equipment. Throughout the course, half the time was given to radio operation, which included instruction and practice in Morse code until the desired speed was attained. The other half of the training day was devoted to the fundamentals of radio equipment. Instruction consisted of demonstrations, laboratory work, inspection, and maintenance practice on types of radio sets in current use. A brief allotment of time was made, primarily for the benefit of students qualified for aircrew duty, to training under simulated flying conditions, and when aircraft were available, one actual flight was made by such students.[20] Soon after Pearl Harbor the ROM curriculum was reduced to eighteen weeks, but after July 1943 this trend was reversed, and by July 1944 the length of training had been extended to twenty-six weeks.

The code characters, representing letters and numbers, were taught chiefly by mechanical means. Sending machines, activated by premarked code tapes, transmitted the signals to the students' headsets. Each tape contained a small number of characters arranged in repetitive sequences; the machines could send the signals at any desired speed. As the student received the code signals through his headset, he printed the corresponding characters on a sheet of paper before him. In the latter part of 1942 a successful modification of this system was introduced. Called the "quacking" or "dit-dah" method, it encouraged students to think of the code signals not as "dots" and "dashes" but as "dits" and "dahs," sounds which approxi-

mate those of the short and long code signals and thus provided an aural, rather than a visual, identification for each character. This method substantially reduced the amount of time required to master the code, but many individuals continued to have difficulty and complained of the monotony of code instruction.[21]

Some men were trained solely in radio operation. Entrants in this course were usually those who did not show sufficient aptitude as mechanics but who had shown high aptitude for sending and receiving code. Training in radio maintenance, exclusive of operation, was also open to men of mechanical aptitude who could not attain the required code speed. The instruction received by these students was more advanced than the maintenance portion of the standard ROM course and was followed by specialized training, through third and fourth echelons, in the maintenance of ground-controlled radio-interception equipment, radio-range, direction-finding, or instrument landing devices. Most of the graduates from these specialized courses were assigned to the Army Airways Communications System. Students who failed to meet minimum requirements in either radio operation or maintenance were the principal source of entrants into the control tower operator course. These men were trained to assist in the control of air traffic in the vicinity of a landing field through established procedures of ground-to-air communication.[22]

Officer training in radio communications, originally located at Chanute Field, was transferred to Yale University in 1943. The standard course for cadets there in 1944 lasted twenty weeks; it paralleled the enlisted ROM curriculum but included additional material on the administrative duties of a communications officer. At the end of 1944 the program was removed from Yale to Scott Field, pilot officers were entered in place of aviation cadets, and the curriculum was accordingly modified.[23]

The radar training programs were marked by much more specialization. The term "radar," a word coined from "*ra*dio *d*etection *a*nd *r*anging," was almost as new to the AAF as it was to the general public. Following plans made in the summer of 1941, a limited number of officers were detailed to the Massachusetts Institute of Technology for training in the use of radio detection equipment; the first radar course to be given by the AAF was started in November of that year at Scott Field. The number of courses and students increased steadily until January 1945. Although enrollment gradually

declined thereafter, at war's end the radar program was still operating on a substantial scale. Between Pearl Harbor and V-J Day over 85,000 men graduated from radar courses--the majority of them trained for ground technical duties.[24]

Frequent modifications in radar equipment, the early shift from defensive to offensive use of radar, and the experimental nature of radar itself produced repeated changes of curriculum for the instruction of radar mechanics. Not until late 1944 was relative stability achieved. After that date graduates of a special radio-mechanic course at Truax Field, Wisconsin, normally took a six-week course in electronic fundamentals at Chanute Field, after which they took a thirty-day general radar-mechanic course at Boca Raton Army Air Field, Florida. Graduates from this series of courses were then entered into one of the many advanced curricula taught at Boca Raton. In the advanced mechanics courses, which ranged in length from twelve to sixty-four days, the men specialized in radar equipment common to a particular type of unit or assignment. One course, for example, taught maintenance of night fighter radar devices; another taught maintenance of bombing-through-overcast equipment; and still another was concerned with radar navigation instruments.[25]

The majority of officers receiving radar instruction were flyers, but many nonflying officers were also given training. The ground officers had to be graduates of the radio communications course, and most of them were entered in a twenty-week program for qualification as electronics officers. The curriculum consisted of training in the maintenance of all important types of radar equipment, as well as in procedures for general supervision of squadron radar operations. Some students followed an alternate pattern: after twenty-eight weeks of electronics training at Harvard University or the Massachusetts Institute of Technology, they went to Boca Raton for an abbreviated eight-week course similar to the standard radar officer curriculum. In October 1944 a radar program for intelligence officers was started at Langley Field, Virginia. It consisted of four weeks of study of radar principles, scope interpretation, radar navigation and bombing, target analysis, and mission planning. Graduates, classified as radar intelligence officers, had the job of planning missions for radar-equipped aircraft and briefing and interrogating their crews.[26]

Communications training included, in addition to radio and radar, several courses in teletype transmission and cryptography. Courses lasting from twenty-five to forty-eight days gave specialized instruction in maintenance and operation of teletype equipment at Chanute Field during most of the war. Separate cryptographic schools were conducted for enlisted men and officers. Students were chosen with special care for the four-week course; officer and enlisted curricula were similar in scope, except that the officer course included problems of administration and supervision. The location of this training was changed several times, and in June 1945 both schools were moved from Chanute to Scott Field.[27]

Individual Training in Aircraft Armament

The combat airplane was far more than a flying machine. It carried an array of complicated lethal machinery: machine guns, cannon, and bombs, as well as the necessary equipment for their operation and control, such as gun turrets, bombsights, and its companion piece, the automatic pilot. All such equipment was designated aircraft armament; closely allied to aircraft armament were the spray tanks and other containers with which planes were fitted for the conduct of chemical warfare should it be required.

Since the general airplane mechanic was not qualified to care for this highly specialized equipment, it became necessary to train thousands of experts in armament maintenance—more than 160,000 all told.[28] Before Pearl Harbor the airplane armament course given at Lowry Field, Colorado, lasted fifteen weeks and included instruction on both fighter and bomber armament. As the war progressed, the curriculum changed frequently, and the number of subjects included were steadily increased. The major curricular problem was that of general versus specialized training. With the aim of shortening the training period and thereby speeding the production of graduates, separate fighter and bomber courses, each nine weeks long, were established in September 1942. Such a program, however, introduced an element of inflexibility into the problem of assignment, and after shifting back and forth between the dual and the combined program, the Training Command in March 1944 achieved a compromise solution. A streamlined seven-week course was divided into two parts: students received twenty days of general armament instruction, followed by twenty-two days of specialization on the

B-17, B-24, or medium bomber types; fighter armament training was discontinued altogether. In November 1944 a specialized course in B-29 armament was added. Only students qualified for aircrew gunnery were admitted to the new program since by that time a surplus of ground armorers was in sight. In April 1945 all specialized armament courses were ended. Demands for heavy and medium bomber armorers had been met, and it had been found that B-29 gunners were so occupied with operation of their weapons that they had no time to perform maintenance. With the pressing requirements for speedy training removed, the AAF returned to a unified, comprehensive course. A reorganized twenty-week curriculum was placed in effect at Lowry Field in the summer of 1945. The contents of the various armament curricula were generally similar, differing only in emphasis and in the specific equipment studied. Principal subjects included were explosives and ammunition, bomb racks, electrical armament controls, aircraft machine guns and cannon, installation and harmonization of weapons, gun sights and cameras, and power turrets.[29]

Since the general aircraft armament course could do little more than introduce the student to the special problems involved in the maintenance of power-operated turrets, specialists had to be trained for the work. At Lowry Field, a course on first and second echelon maintenance of the main types of turrets and computing sights was reduced from twelve to eight weeks in length early in 1942. Shorter courses, limited to the equipment of a particular manufacturer, were given by various factory schools as supplements to the instruction at Lowry Field. When the B-29, with its unique system of central fire control, came into operation, a sixteen-week course for maintenance of the new type of armament equipment was inaugurated at Lowry. Entrants into this program had to be graduates of the standard turret course.[30]

Probably the most intricate of the devices carried by a combat aircraft was the bombsight, which required an expert for its maintenance. Training of bombsight mechanics, involving elementary electricity, theory of sighting, and principles of gyroscopes, as well as the construction and disassembly of the device itself, lasted from twelve to twenty weeks. Beginning in 1943 it was possible to require graduates of the course to spend an additional eight-week

period performing on-the-line bombsight maintenance at bombardier schools before assignment to combat units.[31]

While the Technical Training Command was arranging and providing the necessary instruction for first and second echelon armament maintenance, the Air Service Command took steps to train enlisted men for depot overhaul work. In June 1942 it established the Armament Training School at the Indiana State Fairgrounds, Indianapolis. Courses were taught in the repair of turrets, bombsights, and central fire-control equipment; students were civilian employees of the depots or graduates of first and second echelon armament programs. In February 1944 the Indianapolis school was closed, and the courses were moved to Lowry Field.[32]

Admission to training for assignment as squadron armament and chemical officer, an officer charged with supervision of bomb-loading and armament maintenance, was limited shortly after Pearl Harbor to eliminated aviation cadets who showed mechanical aptitude. The course was given first at Lowry Field, but was transferred in January 1943 to Yale University, where it remained until June 1944. The course was then removed to Buckley Field, Colorado, and was restricted to pilot officers returned from combat. The curriculum was steadily expanded during the war to include all subjects in the field of armament and related equipment, as well as chemical warfare and administration. Instruction in this diversified program required eighteen weeks. For a brief period, when the demand for armament officers was very pressing, selected instructors and graduates of the enlisted armament courses were given a special six-week course which led to commissioning.[33]

Individual Training in Aerial Photography

During the war great strides were made in the art of aerial photography, and this means of reconnaissance became indispensable to planning, executing, and appraising a wide variety of military operations. Having a large share of the responsibility for training personnel in this work, the AAF developed, in addition to aerial photographers, such specialists as camera repairmen, laboratory technicians, and cinematographers. Between 1939 and August 1945 more than 17,000 men graduated from AAF photographic courses.[34]

The central problem in training photographic personnel, as in the case of most other technicians, was determining how much instruc-

tion should be general and how much specialized. As the demand arose for an increasing variety of photographic experts, continual adjustments in the curricula had to be made. The main courses were repeatedly combined, subdivided, separated, and recombined.

The two major photographic courses were for laboratory and camera technicians. In the early part of 1944 they were recombined after a considerable period of separation. All personnel entering this combined program took the ten-week laboratory-technician phase, at the end of which the enlisted men in the course entered a ten-week camera-technician phase, and enlisted WAC's entered a six-week photographic mosaic course. The laboratory-technician phase included such subjects as general photographic principles, optics, photographic chemistry, printing, copying, vectography, and operation of photographic units. In the camera-technician phase students were taught how to install, maintain, and repair aerial cameras. In July 1944 a program was instituted to train aerial photographers and aerial photographer gunners; this was accomplished by providing an additional phase, which was taken at the end of the regular laboratory-camera-technician course by students qualified for aircrew duty. The extra two-week period was taken up with instruction in photographic-mission planning, loading and unloading the various types of cameras, and actual experience in flying photographic missions. As combat conditions demanded, various other short courses were set up from time to time. In the spring of 1945, for example, a brief program in radarscope photography was established to teach the fundamentals of radar and photography, the use of radar equipment and cameras, and the processing of films. Courses were also given at various times for phototopographers and aerial motion-picture photographers.[35]

The aviation cadet photographic course, or the laboratory commander course as it was often called, was begun at Lowry Field before the United States entered the war. The development of photographic officer training closely paralleled that of courses for armament cadets. Instruction was in both instances transferred to Yale University during the war, and the full-length cadet course was supplemented by abbreviated officer courses for selected graduates and instructors of the standard enlisted programs. The laboratory commander course, as taught in the twelve-week curriculum, consisted of the fundamentals of laboratory and camera work, in addi-

tion to administrative functions. After early graduates had shown deficiencies in performing their administrative and supervisory duties as laboratory commanders, special emphasis was placed on this phase of their work.[36]

Individual Training in Weather

Weather affects all flying, and its importance to military flying can be crucial. In order to get the weather information essential to its operations, the AAF maintained in the AAF Weather Service a world-wide chain of weather stations for observation and forecasting of atmospheric conditions. Routine observation and recording of weather data were performed by enlisted personnel of the lower grades, and the analysis of weather maps and the preparation of forecasts were made by commissioned officers and enlisted personnel of the higher grades.

The training of meteorological personnel was first undertaken by the Air Corps on a very small scale in 1937, when the Army transferred responsibility for weather information from the Signal Corps to the air arm. The program was concentrated at Chanute Field in 1940, at which time courses in observing and forecasting were being taught to enlisted men; toward the close of the year a meteorology program for aviation cadets was being developed in a number of cooperating colleges and universities. As the weather program expanded, it was found necessary to supplement existing facilities by creating a Weather Training Center in Grand Rapids, Michigan. Instruction was carried on there for only a short period, however, because the properties leased for this purpose had to be relinquished during October 1943. Shortly thereafter, as the demand for weather personnel abruptly declined, the major training courses were suspended. Most of the programs for both enlisted men and officers were resumed on a limited basis, however, before the end of the war. During the period from July 1939 to September 1945 more than 20,000 students graduated from the various weather courses.[37]

One of the basic courses was for weather observers. Graduates of this training were normally assigned to weather stations, and their duties consisted of noting meteorological data such as temperature, dew point, atmospheric pressure, force and direction of wind, visibility, and type and amount of clouds. The observer at each station recorded his data, transmitted it to other stations, and received

similar reports in return. Nearly half of the observer-training course was devoted to practical exercises in decoding weather reports and entering the data on weather maps. The curriculum included also the care and repair of weather instruments and the taking of surface observations. Background instruction in elementary meteorology gave students some theoretical knowledge as a basis for the performance of their everyday duties.[38]

While the ten-week observer course stressed practical exercises, the enlisted weather forecaster curriculum was concerned largely with theoretical concepts. After Pearl Harbor the forecaster course, one of the most difficult of the Air Corps' technical programs, was reduced to twenty-two weeks in length. A considerable portion of the curriculum was devoted to background subjects, such as algebra, trigonometry, calculus, vector analysis, electricity, and heat. This preparation was followed by meteorological subjects: radiation, atmospheric pressure, temperature distribution, circulation, air mass and frontal analysis, and mathematical formulae pertinent to forecasting. Subjects from the weather observer course were included until late 1942, when it became possible to restrict entrance in the course to graduates of the standard weather observer program. Using current weather data, students prepared weather maps and charts and made forecasts on the basis of their work. Increasing availability of weather officers altered the objectives and content of the enlisted forecaster course early in 1943. Until that time the enlisted forecasters had usually served as the key personnel at weather stations, but thereafter the weather officers assumed the responsible forecasting activities, and enlisted forecasters served as their assistants. The enlisted curriculum was revised to place more emphasis upon the preparation and use of forecasting aids and less on theoretical meteorology.[39]

The need for weather officers with advanced educational background and complete meteorological training had been recognized when the Air Corps began its wartime expansion in 1939. To provide qualified commissioned personnel for its growing number of weather stations, the Air Corps decided to enroll selected men as aviation cadets in graduate meteorology courses at five universities; prerequisites for the course were a college degree in science or engineering and age not over twenty-six years. Recruiting of students began during the summer of 1940, and instruction began at

each of the chosen universities in the fall. Although each succeeding cadet class was larger than its predecessor, production of weather officers did not equal anticipated requirements during 1941 and 1942. In order to secure more students, educational prerequisites were lowered to the completion of two years of college, with courses in mathematics and physics; in addition, a pre-meteorology program was established in selected colleges early in 1943. Students with only a high school education or one year of college were recruited and put into this program as enlisted men. But it soon became evident that requirements had been overestimated. In the summer of 1943 the meteorology program was so far curtailed that only one class of pre-meteorology graduates entered the cadet phase.[40]

Training of meteorology cadets was halted after June 1944. A similar course was started early in 1945 at Chanute Field, but entrance was restricted to commissioned flying personnel with the requisite educational qualifications.[41] At about the same time a special program for training weather reconnaissance officers was launched. In areas where weather reports were unavailable, the only way of securing data was through reconnaissance flights; the aerial observer obtained the desired information both visually and through operation of airborne weather instruments. Photographic reconnaissance pilots were first given the necessary training, but the program was later opened to other types of pilots, navigators, and graduate weather officers. The fifteen-week course, suspended in June 1945, gave a general meteorological indoctrination, but it placed special stress upon the physical appearance of weather phenomena.[42]

A number of specialized courses for trained meteorological personnel were offered during part or all of the war. Some enlisted observers and forecasters were taught to operate the important radiosonde. This equipment was attached to a free balloon, which ascended to a height of ten to twelve miles; at that altitude the balloon burst because of reduced atmospheric pressure, and the radiosonde descended on a small parachute. During its flight up and down, the radio device automatically transmitted signals, indicating temperature, pressure, and humidity aloft. Instruction of operators required nine to ten weeks. Other special courses for selected weather forecasters and weather officers included maritime meteorology, tropical meteorology, operation of weather radio equipment, and micrometeorology, which was related to chemical warfare operations. These programs ranged in length from three to eight weeks.[43]

Individual Training in Arms and Services Specialties

Although the greater part of the AAF was composed of its own personnel, the troop basis authorized by the War Department for the AAF included large numbers of men from other branches of the Army as well. In April 1943, for example, enlisted personnel from the other arms and services who were assigned to the AAF made up one-quarter of the total enlisted strength of the air arm. In November of that year the AAF was authorized to integrate arms and services personnel into the AAF proper, but the transfer was subject to numerous restrictions and progressed slowly. ASWAAF personnel performed duties which had been traditionally outside the sphere of Air Corps functions, such as those belonging to the Medical, Ordnance, and Finance Departments, the Signal, Engineer, Quartermaster, and Military Police Corps, and the Chemical Warfare Service. Most of the enlisted personnel of these branches were classified as nonspecialists and did not attend service schools. Appropriate training for specialists was provided partly by the AAF and partly by the particular branches concerned, but in keeping with the move toward integration of arms and services personnel, the AAF assumed increasing control over their training.[44] If enlisted men, they were usually sent to AAF basic training centers before assignment to units or schools, and after 1943 distinctions in treatment between AAF and ASWAAF personnel were less and less apparent.[45]

Personnel of the Medical Department who required specialized instruction generally received it at the medical establishments of the Army Service Forces. But there were special medical problems related to the flying of airplanes, and the School of Aviation Medicine at Randolph Field had become a center, well before 1939, for special training of flight surgeons and their technical assistants. There medical officers received a basic course of three to four months' duration which qualified them as aviation medical examiners; after a minimum of one year's active duty as examiners, the officers were normally given the rating of flight surgeon. A considerable number of medical officers, in addition to those enrolled at Randolph Field, took the basic program by means of a longer extension course.[46]

The wartime curriculum for enlisted assistants to flight surgeons was six weeks long. Subjects included were the care and operation

of examining apparatus, aircrew physical requirements and measurements, laboratory analysis procedures, hospital administration, sanitation, and tropical medicine. Late in 1944 the School of Aviation Medicine assumed control of a special course in air evacuation of the sick and wounded, a course which I Troop Carrier Command had originated in June 1943 at Bowman Field, Kentucky. Students were taught the professional, technical, administrative, and tactical procedures of air evacuation. Another function transferred from Bowman Field to the School of Aviation Medicine was the specialized training of Army nurses assigned to the AAF. Instruction of WAC medical technicians was conducted during the war at selected hospitals of the AAF Training Command.[47]

Of special interest was the AAF Medical Service Training School, established in November 1943 at Warner Robins Air Depot, Macon, Georgia. This instruction was an outgrowth of a course previously given at Warner Robins to personnel of the Air Service Command. Although the school was placed under ASC's administrative jurisdiction, it served the AAF as a whole. The aim of the program was to prepare medical personnel for field assignments. Enlisted men who came to the school as hospital-trained specialists were oriented to the problems presented by combat conditions and the techniques for dealing with them. They studied and practiced heavy tent-pitching, map reading, chemical warfare, field sanitation and emergency medical care, defensive measures, and bivouac procedures. A comparable course, also six weeks in length, was given to Medical Department officers. The school also conducted unit training for AAF medical dispensaries and medical supply platoons.[48]

Specialized training of Quartermaster personnel, such as cooks and bakers, mess inspectors, and supply clerks, was provided almost entirely by Quartermaster schools. Although officers of the Chaplain Corps received their specialized indoctrination at the Army Chaplain School at Harvard University, brief supplementary courses were frequently provided by the AAF. In 1944, for example, a school for chaplains and their assistants was established at the San Antonio Aviation Cadet Center. Signal Corps personnel were generally given individual training in regular schools of that branch, but some AAF communications courses, chiefly those for radio operators, were open to Signal personnel. A considerable amount of specialist instruction was also given at AAF signal aviation unit training centers.[49]

During the war the Chemical Warfare Service gave most of the individual training required by personnel of that branch, although some courses were given by the Air Service Command. Late in 1944 an AAF center for chemical warfare training was activated at Barksdale Field, Louisiana; in the spring of 1945, in keeping with an over-all plan to concentrate AAF service training activities at Buckley Field, Colorado, the center was moved from Barksdale to Buckley and from the jurisdiction of the Third Air Force to that of the Training Command. The program taught at Buckley included a chemical munitions and materiel course and courses for chemical technicians, decontamination-equipment operators, and toxic-gas handlers. These curricula were intended to provide instruction for all chemical specialists needed by the AAF.[50]

A Military Police School was established in June 1943 at Camp Ripley, Minnesota, under ASC's supervision. The courses, open to both AAF and ASWAAF personnel, were designed to train individuals and units for guard duty at AAF installations. The school moved several times, eventually becoming the first organization to function at the proposed service training center at Buckley Field. Courses offered there, other than unit training, included separate AAF Guard Courses for officers and for enlisted men, and a program for training provost marshals and military police commanders.[51]

Also established at Buckley Field in 1945 was a post engineer course. Officers selected to take this eight-week curriculum had to be college graduates in engineering or have equivalent experience. Camouflage instruction, which had been started by the AAF early in 1942 at Hamilton Field, was moved to Buckley; a number of officers from the AAF, as well as from the Corps of Engineers, were enrolled in this course. The principal responsibility for all individual engineer instruction remained, however, with the Corps of Engineers.[52]

The Finance Department maintained a training center at Fort Benjamin Harrison, Indiana, and the Army Finance School at Duke University, Durham, North Carolina. These institutions provided most of the individual training required, but in April 1945 the AAF took steps to establish its own finance school for enlisted personnel at Maxwell Field, Alabama. AAF finance training was transferred to Lowry Field in October 1945, in keeping with the general plan to concentrate such activities at or near Buckley Field.[53]

Throughout the war the greater part of individual ordnance training for the AAF, particularly that of third and fourth echelon specialists, was conducted by the Ordnance Department. In order to supplement the graduates of the service schools and to provide sufficient numbers of technical personnel for operational training units, the First Air Force instituted its own ordnance training in February 1943. The First Air Force program, taught at two schools, consisted of instruction and practice in ordnance supply procedures, automotive maintenance and operation, small arms, and ammunition supply and issue. Graduates of the course were usually absorbed into ordnance sections of the operational training squadrons. After the middle of 1944 the ordnance program of the First Air Force, being no longer needed, was terminated.[54]

Training Procedures and Problems

Although hundreds of specific courses were taught in the individual technical and service training programs, the basic instructional methods used were similar almost throughout. Primary responsibility for developing educational policies rested with the AAF Training Command (and its predecessor, the Technical Training Command), which conducted the bulk of individual technical instruction.

During the first year of war the shortage of teachers and equipment overshadowed all other problems. As a result, graduates of technical courses showed serious deficiencies on the job. Lack of up-to-date training equipment made it necessary to devote a disproportionate share of time to lectures and theory; General Arnold himself, after a personal inspection, deplored the amount of theoretical data included in technical courses and directed that instruction be made pragmatic. Arnold's criticisms of technical training in August 1942 prompted the commanding general of the Technical Training Command, Maj. Gen. Walter R. Weaver, to issue a series of orders aimed at achieving a drastic shift toward practical methods. Some of these directives were carried out fully and some only partly; others proved totally impossible of execution.[55]

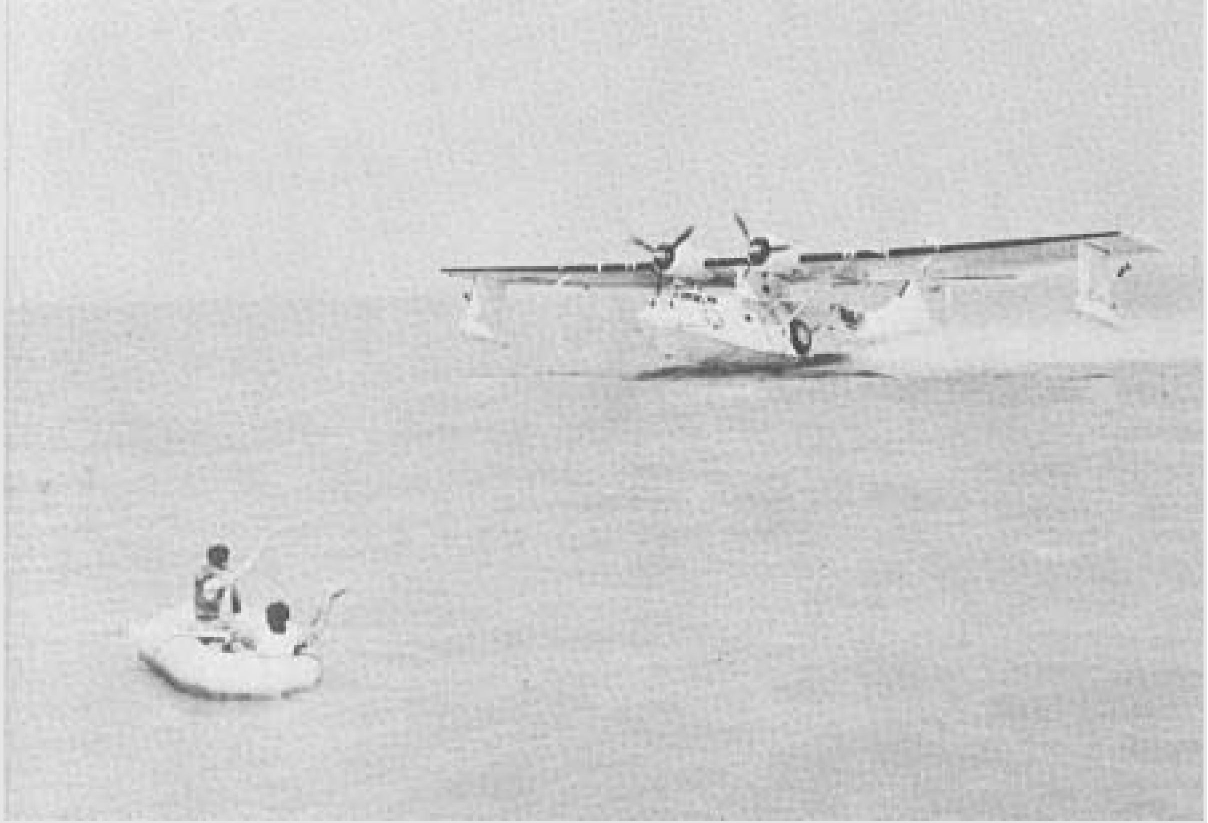
The first of the Weaver directives, issued in September 1942, placed all TTC schools on a twenty-four-hour day, seven-day week basis. This innovation was intended primarily to allow maximum employment of available instructional equipment; moreover, by dividing classes into three or four shifts, instead of the existing two,

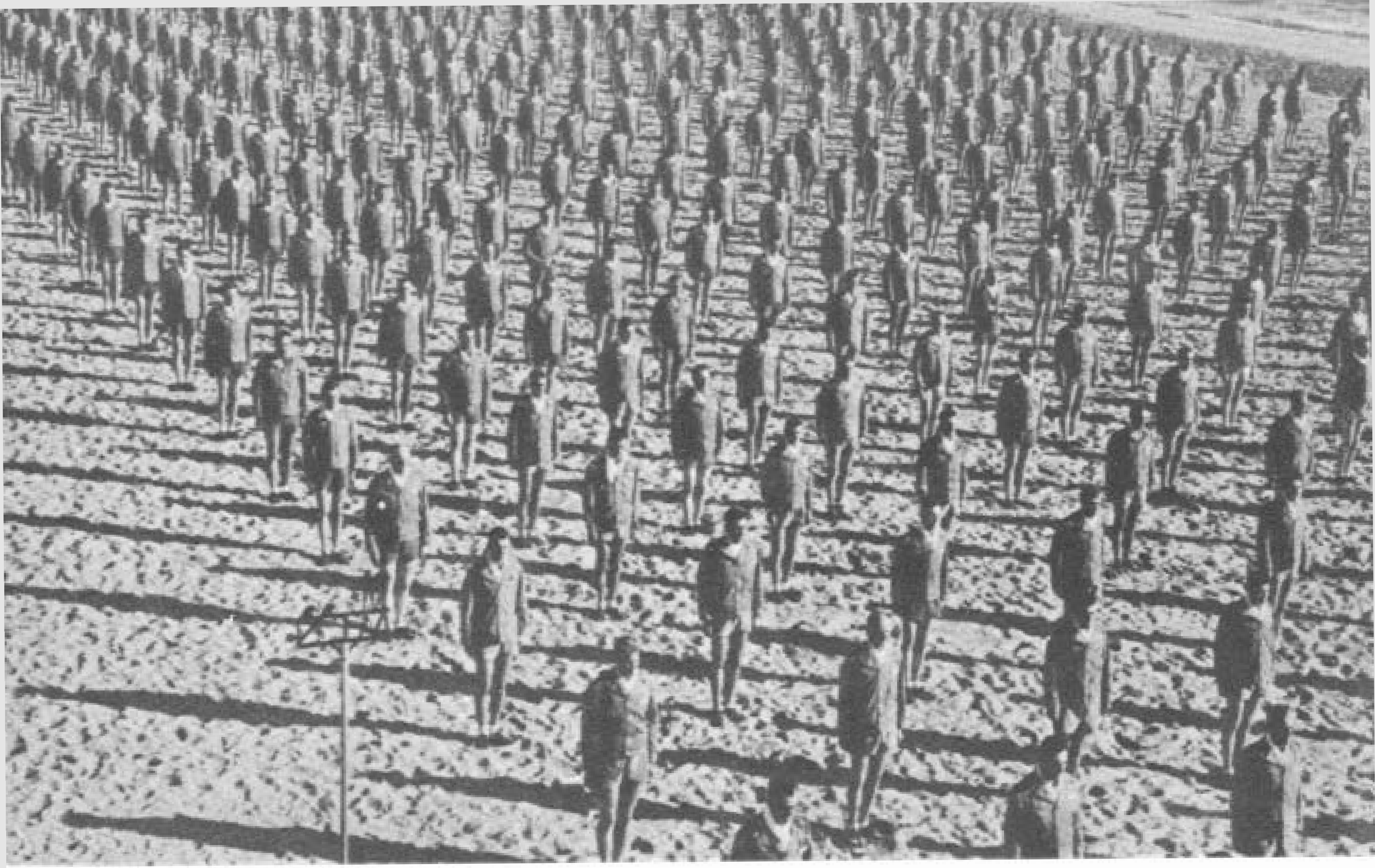
each shift would have fewer students and therefore a lower ratio of students to equipment. More radical changes were ordered in October, when it was directed that lectures be abolished and that the demonstration and practice technique be substituted. The standard plan of instruction contemplated small groups of students gathered around workbenches, observing their teachers perform the actual operations to be learned. The instructor would explain as he proceeded, and students would ask questions. Following the demonstration, the students would themselves perform the same operations on the equipment, while the instructor supervised their work, corrected errors, and answered questions. As a means of discouraging any surviving inclination on the part of teachers to lecture, blackboards and chairs were later ordered removed from all classrooms.[56] Abolition of written examinations was directed concurrently with the order to eliminate lectures. It was believed that the existing system of written tests fostered a false objective by tempting instructors to teach students to pass an examination rather than to perform the duties for which they were being trained. In place of grading by written tests, it was directed that instructors give each student a daily grade based upon daily performance and an over-all grade for each major phase of a course. The final step in this effort to make instruction practical and realistic was a directive of April 1943, which required students to perform theater-of-operations duties. In order to simulate theater conditions, fixed sites for this phase of training were prohibited, so as to give students experience in setting up necessary installations.[57]

Although the Weaver directives were generally sound in principle, the insistence upon immediate compliance proved disruptive to the training program. Gradual adoption of the prescribed methods, with allowance for variation in specific instances, might have been both practicable and desirable. But the new orders were couched as imperatives; they were to be followed strictly, without consideration of what was reasonable or possible. The change to a twenty-four-hour day, seven-day week schedule was opposed on the ground that it would require additional instructors and higher operating costs; some of the civilian contract schools never adopted the schedule, and others abandoned it early in 1943. The elimination of lectures was not fully accomplished, because it was not possible to secure the requisite number of instructors or the necessary quantity

COMMUNICATIONS TRAINING, SCOTT FIELD, ILL.

AIR-SEA RESCUE TRAINING, KEESLER FIELD, MISS.





CALISTHENICS, OCS, MIAMI BEACH, FLA.

of equipment. In courses such as weather forecasting, which required understanding of theoretical concepts, it was inadvisable to eliminate lectures altogether, even if all needed equipment were available. It was apparent that the lecture-discussion technique was the most efficient method of communicating some types of necessary knowledge.

Probably the least successful of all the new directives was the order to abolish written examinations. Although the nature of written tests was modified, some form of this traditional measuring device was continued in most schools. Since grading, and elimination based on grading, were still required, the instructors had to have some reliable means of evaluating the work of their students.[58]

Soon after the TTC was merged into the AAF Training Command under Maj. Gen. Barton K. Yount, the "practical" program was modified. The basic principles of the new methodology were retained, but the schools were allowed greater flexibility in applying them. Classroom lectures were allowed when other methods proved inappropriate; their use was discouraged, however, and informal discussions were urged in their place. The modified policy, promulgated in October 1943, also permitted limited use of written tests.

In order to help implement the new program, which was built upon the practical, problem-solving approach, the Training Command directed that project sheets be prepared to outline each practical problem in the various technical courses. Instruction was to be arranged in blocks, so that teachers could specialize in one portion of a course and students could take just the phase of training which their duties might require. The modified system proved generally successful; this result was due to the greater reasonableness of the directives, the relaxation of demands for technical graduates, and the augmentation of equipment and teaching personnel. During 1945 several experiments contributed to further improvement of instructional methods. One of those worked out, applicable to most technical courses, was a model phase technique which comprised a planned sequence of lectures, demonstrations, and student performance of the operations involved.[59]

The instructors were, of course, the primary instruments in carrying out the training program. With the emphasis upon direct, practical instruction in 1942, strenuous efforts were made to reduce the student-instructor ratio to about six to one. Exceptions were made for teaching code, typing, and other subjects where it was efficient to

work with larger groups of students. In some cases the attempt to accelerate expansion of instructional staffs brought about the assignment of unqualified individuals, and it was not until 1945, as a consequence of declining enrollments, that satisfactory student-instructor ratios were achieved in most programs.

In order to secure technical instructors, several sources of manpower had to be utilized. Officers were rarely assigned to these duties; enlisted men and civilians made up the bulk of the force. In June 1942, as a means of making the maximum number of trained military personnel available for combat, the AAF directed that all enlisted instructors be replaced by civilians. The principal obstacle to fulfillment of this objective was the fact that there were relatively few qualified civilians who were not subject to military induction through the Selective Service System. Although the contract schools and colleges employed civilians exclusively, replacement of enlisted instructors at the military schools did not prove feasible. This was tacitly recognized in January 1943, when the policy was reversed. Increased emphasis was placed, however, on supplanting general-service men with limited-service personnel. Notwithstanding these efforts, it became necessary during 1943 to retain as instructors many general-service graduates of technical courses. This measure was approved as an expedient in order to meet the rising demands for technical specialists; by late 1944 combat returnees provided the necessary replacements.[60]

The majority of technical instructors lacked thorough knowledge of their subjects, practical experience in performing the duties which they taught to students, and professional training in the art of teaching. Many instructors, furthermore, did not desire their assignments, and the relatively low rank available to them as teachers discouraged initiative. This situation made constant supervision and training of instructors imperative even after they had been teaching for some time. Newly assigned instructors were generally enrolled in special classes taught by the more experienced teachers; both subject matter and teaching methods were reviewed. In addition to this form of indoctrination, the new teachers usually spent several days observing regular classes. Continuation training, consisting chiefly of advanced subject matter and re-emphasis upon instructional methods, was prescribed and conducted for all teachers. The "in-service" courses were rarely

satisfactory, and most of the experienced teachers resented what they considered to be an unnecessary inroad upon their off-duty hours. Efforts to increase the competence of instructors took other forms as well. From time to time, as student enrollment permitted, teachers were detached for temporary duty with mobile or operational training units within the continental United States. This practice, while limited, gave instructors a better appreciation of the practice of technical skills in the field, and at the same time improved the instructors' morale.[61]

For a number of years before Pearl Harbor a high school education had been required for entry into Air Corps technical training, but as the demand for technicians increased, it became necessary to lower standards and to make them more flexible. In November 1940 the general requirement for entrants in technical courses was a score of 100 or above on the Army general classification test, and a designated minimum score on the aptitude test for a given specialty. By February 1943 the technical schools were permitted to enroll men having an AGCT score as low as 85, and less than 85 if in the opinion of classification officers such men had enough background or experience to qualify them for a given specialty. In April 1944 the minimum AGCT score requirement ranged from 70 for assignment to Cooks and Bakers School, to 120 for crytographic technician training. Because of the preferential treatment given the AAF, the other arms and services got more than their share of the less intelligent recruits.* Since personnel assigned from other branches for duty with the AAF normally represented a cross section of their branch of origin, ASWAAF personnel sent to AAF schools tended to lower the average of the students' performance.[62]

The elimination rates fluctuated for the various specialized courses and reflected for any given period the entrance qualifications of the students enrolled. In AAF schools the weather courses generally showed the highest rate of failures—in 1943 almost 30 per cent were eliminated. In contrast, a relatively low number of clerical trainees were eliminated, averaging about 5 per cent during most of the war. Most of the failing students in technical courses had relatively low general aptitude scores. In radio operator training, for example, nearly half of the entrants having AGCT scores below 100 were eliminated.

* See above, pp. 540–42.

Consequently, when the demand for students was most critical and minimum entrance qualifications were waived in particular programs, the rate of failure mounted sharply. Standard practice during the war was to dispose of eliminees in the following manner: unassigned personnel were enrolled in other courses or reported available for general assignment, while assigned personnel were returned to the organizations from which they came. Graduates, if not retained as instructors, were normally transferred to appropriate units for operational training.[63]

Several persistent causes lowered the morale of students in technical and service courses. Although a great number of these men, probably the majority, adjusted themselves satisfactorily to the training they were getting, others were unable to do so. The underlying difficulty was the necessity of assigning men to training contrary to their choice; indeed, it was equally true that many were in the Army against their will. If more time had been available and if the demand for individual specialists had conformed more closely to the training desires of the men, more satisfactory assignments could have been made. In the pressure of events, however, classification and assignment were frequently guided more by the need to fill specific school quotas than by the aptitude and predilection of the men. Malassignments, some avoidable and some unavoidable, naturally resulted in discontent.

Student dissatisfaction was aggravated by conditions in the schools themselves. Daily schedules were extremely crowded, especially during 1942 and 1943, and the three-shift system then in operation reduced the amount of sleep obtained by many students. Furloughs were generally not permitted while students were in a training status, and this policy proved especially irksome to men who might be in a training sequence for six or seven months. Furthermore, when demands for graduates were especially heavy, furloughs to which men were normally entitled before proceeding to their next assignment were canceled. The particular groups of trainees whose adjustment proved most difficult were former permanent party enlisted men who were taken from their assigned organizations in order to fill school quotas, eliminated aircrew trainees who disdained any form of ground duty, and combat returnees who generally resented the personal restrictions imposed by school regulations.[64]

Training of Ground Echelons of Combat Groups

The individually trained specialists who were assigned to combat or maintenance organizations required additional instruction before they were ready to work effectively. As with flying personnel, it was necessary to mold these individuals, along with nonspecialized personnel, into functioning teams. Such unit training was achieved largely through on-the-job learning and practice, but it frequently involved more formal types of instruction. In any case, the most successful programs were guided by carefully planned and coordinated schedules.

The bulk of ground technicians and service personnel was assigned to maintenance organizations, but many thousands were required for manning the ground echelons of combat groups. The continental air forces and the I Troop Carrier Command were primarily responsible for training these ground units, and the program was carried on in conjunction with crew and unit training of the flight echelons. When operational training units were being created and prepared for action, cadres of technicians, as well as administrative and flight personnel, were selected and given appropriate instruction or experience. Some were sent to specialist schools, either in the AAF or in another branch, while the remainder learned on the job. Following this training, the cadre was expanded until the full strength of a combat group was reached.

Instruction of the ground echelon, from the time of activation of the group, was normally divided into two phases. The first, or developmental, phase usually lasted three months. During this time basic military training was given to men who had not previously received it, personnel were assigned to sections according to their classification and experience, and individuals requiring additional specialized instruction were sent to appropriate technical schools or training assignments. Unit and combined training were emphasized during the second phase, which was also about three months long. Individuals became working members of functioning sections, while the sections and squadrons became integrated parts of the combat group. The ground echelon of a group, except for a few individuals, was assigned to the constituent squadrons. Enlisted personnel were placed and trained in appropriate squadron sections, such as armament, ordnance, photo, technical supply, communications, chemical, medical, mess, and transportation. Although assigned to individual squadrons, ground

personnel served the group as a whole; they performed all the necessary housekeeping functions and first and second echelon supply and maintenance.[65]

In order that all elements of a group might arrive at a theater destination at approximately the same time, the ground echelon was usually ordered overseas about six weeks in advance of the air echelon. This arrangement, however, created a new difficulty by depriving the combat crews of the services of their own maintenance personnel during the final period of flight training. Normally, this problem was solved by assigning to an operational base—ahead of its air echelon—the ground echelon of a newly activated group. The new unit served the dangling air echelon of an older group until the latter moved on toward its combat destination; at that time the air echelon of the new group moved in, and integrated operational training was begun.[66]

In the course of overseas operations it was not unusual for the air and ground echelons of a combat group to become separated; this occurred most frequently in the Pacific theaters when leapfrog, or island-hopping, campaigns were under way. In order to provide for such situations, the AAF authorized creation of special maintenance units, called airdrome squadrons. These units performed the same function as the ground echelons of regular squadrons and were substituted for them when a high degree of mobility was desired of the combat groups. Advance airdromes were prepared and occupied by the special squadrons, thus permitting air echelons to hop forward without being limited by the slower movement of their supporting elements. Training of these units, which included some ASWAAF as well as AAF personnel, was delegated primarily to the domestic air forces. The period of instruction was two months, during which basic military, technical, and unit field training were given under supervision of the squadron's officers.[67]

Unit Training of Arms and Services Personnel

While the ground echelons of combat groups were indispensable to air operations, equally important were the activities of attached units and of service and depot groups. The bulk of arms and services units, though performing more or less independent functions, became integral parts of service and depot groups. Before ASWAAF units were ordered into action, either as attached organizations or as elements of a group, it was necessary to give them appropriate unit instruction.

This training was conducted in some instances by the Army Service Forces or the continental air forces, but chiefly by the Air Service Command. The final combined training received by all elements of service and depot groups was the province of the ASC alone.[68]

The mission of the Chemical Warfare Service in the AAF was to provide for defense against chemical attack; advise and make recommendations on the offensive use of chemicals; and to supply all chemical equipment, munitions, and agents. To accomplish these objectives, chemical officers were assigned to headquarters staff positions from air force down to the wing level; below that echelon either officers or NCO's were given additional duty as unit gas officers. For the actual handling, supply, and maintenance of chemical materiel, specialized units were activated and trained. The most important of these, after 1942, were the chemical air operations company, the chemical depot company (aviation), and the chemical maintenance company (aviation). The first of these had the function of filling and decontaminating airplane spray tanks, the second operated chemical ammunition depots, and the third was responsible for major repair and salvage of chemical equipment.

The various chemical units in training were scattered throughout the land, under jurisdiction of the domestic air forces, until June 1942. They were then transferred to the ASC, which shortly thereafter concentrated all chemical unit training in three centers. This concentration of troops made possible more efficient use of the meager equipment available. By agreement between AAF Headquarters and the chief of CWS, newly activated chemical units at Macon, Georgia, were given initial training at the CWS Unit Training Center, Camp Sibert, Alabama. Arrangements were also made between the ASC and other AAF activities for unit exercises in cooperation with operational groups.[69] In keeping with the belief that greater instructional efficiency could be achieved by further concentration of each type of activity, the AAF established a Chemical Training Center at Barksdale Field, Louisiana, in August 1944, to which all unit training was transferred. The center, moved to Buckley Field in 1945, emphasized simulation of combat conditions during all stages of instruction.[70]

Of much greater importance to AAF operations as they developed during the war were the services of the combat engineers, whose mission was the construction, maintenance, and camouflage of forward air bases. The basic construction unit for this type of work was

the engineer aviation battalion, a working and fighting force of approximately 800 officers and men fitted out with about 175 pieces of heavy construction equipment. Other important units were also trained by the AAF for airborne operations, camouflage duties, topographical work, and fire fighting. General-service engineers, who performed required engineering in the rear areas and in the United States, were not trained by the AAF.

The training of engineer units in problems peculiar to air operations was practically nonexistent before the spring of 1941. At that time the First Air Force was given control of the 21st Engineer Regiment and soon afterwards commenced the training of engineer aviation battalions at Westover Field, Massachusetts. Training battalions were subsequently activated under the other continental air forces for the purpose of producing additional units; from the battalions, engineer aviation unit training centers were developed. By V-E Day only two centers remained—at Geiger Field, Washington, and MacDill Field, Florida. The early combat battalions were formed of selected enlisted personnel who had received excellent basic instruction at engineer replacement training centers; their unit training consisted largely of on-the-job experience while engaged in constructing or repairing runways at domestic airfields. General supervision of unit training was exercised by the engineer section of the responsible air force headquarters, while officers of the Corps of Engineers visited the battalions for the purpose of training certain specialists. After the fall of 1943, when the flow of personnel from engineer replacement centers ceased, the AAF centers had to assume responsibility for basic and specialist instruction, in addition to unit indoctrination.[71]

These increased responsibilities resulted in the formal constitution of a series of specialist schools which had actually been operating in the centers for some time. Officer instructors at these schools were usually graduates of one or more Army service schools, and the enlisted teachers were generally selected from graduating classes at the center itself. The entire course of training for engineer aviation battalions usually took about twenty-four weeks, divided roughly into five weeks of basic military instruction; eight weeks of advanced training, according to individual needs; and eleven weeks of unit indoctrination. The special subjects taught, in addition to basic military matters, included airdrome maintenance and patching, repair of bomb damage, rehabilitation of captured and battered airfields, reconstruction of

landing mats, methods of airdrome demolition, and construction of defensive field fortifications. The final phase involved site-surveying, draining, clearing and grubbing, mat-laying, road-building, and erection of airdrome installations. During this phase the vital teamwork of all components was emphasized and practiced.[72] Though never so highly publicized as their Navy counterparts, the Seabees, AAF engineers performed with distinction the world over. The training of airborne engineer battalions began in the fall of 1942 after considerable experimentation by the Air Engineer. These units, with equipment designed especially for cargo transport, were formed for the purpose of accelerating the preparation of advanced landing strips. Instruction was similar to that of the regular battalions although a somewhat longer period was required for specialist training. The airborne battalions also required extensive combined exercises, which were conducted under direction of I Troop Carrier Command and included maneuvers with the Airborne Command of the Army Ground Forces.[73]

Another engineer activity important to the AAF was camouflage training. It was accomplished through engineer camouflage schools in several of the continental air forces and by means of special battalions indoctrinated in camouflage techniques. These battalions were assigned successively to the various air commands of the Zone of Interior; in the course of each assignment companies or detachments of the battalions were dispatched to dispersed airfields for demonstration and instructional purposes. In the latter part of 1944 all formal camouflage training in the AAF was concentrated at March Field, California, although the domestic air forces and the ASC continued to support special programs for the dissemination of camouflage doctrine. In the spring of 1945 the camouflage center was moved from March Field to Buckley Field, Colorado.[74]

Other types of engineering units were also being prepared to meet the specialized demands of air warfare. Among these a small number of aviation engineer topographical companies were trained by the AAF. The typical unit consisted of three platoons, each of which specialized in one of the following: geodetic control, photographic mapping, or map reproduction. Most of the instructional time of these platoons was given to practical exercises in their specialty. The most numerous, although the smallest, of all engineer units developed by the air arm were the fire-fighting and utilities platoons. The fire

fighters were organized to operate the special flame-choking equipment of an airdrome, and the utilities platoons assumed base engineering functions. Beginning in 1944, in the interest of greater efficiency, the separate units were supplanted by larger, combined fire-fighting and utilities platoons.[75]

Although separate units of finance personnel were not activated for service with AAF organizations, it was necessary for the AAF to train finance sections for group headquarters and headquarters squadrons. The finance sections were small, including but two officers and ten to fifteen enlisted men. This service included disbursement of public funds to military and civilian personnel for services rendered, supervision and maintenance of fiscal records, preparation of all types of payment vouchers, and in some theaters responsibility for the audit of military property accounts. In the early days of the war no qualified finance personnel were available within the ASC, and the ASF training center at Fort Benjamin Harrison, Indiana, was requested to assign finance complements to the command. By 1943 a sufficient number of qualified finance personnel was available at ASC bases to meet the requirements of new groups. After receiving the necessary individual training, such personnel were assigned to groups for on-the-job experience as working finance sections.[76]

There were only two military police units in which the AAF was interested: guard squadrons and aviation military police companies. The former were trained to perform interior guard, traffic control, riot control, and vice control duties at continental installations; the latter performed the same functions overseas. Personnel for the units, most of whom had already received individual police training, were drawn from the AAF as well as other arms and services. Before 1943 the guard organizations received their unit indoctrination at air force and command bases throughout the United States. They were trained sometimes as separate organizations, sometimes as parts of station complements; standardization of control and method was lacking. In May 1943 a Military Police Training Center (Aviation) was activated at Camp Riley, Minnesota, under ASC's administrative supervision. The center, which was moved several times afterwards, was finally located at Buckley Field, under jurisdiction of the Training Command. The center provided, in addition to individual instruction, cadre training for all guard squadrons and aviation military police companies required by the AAF. Emphasis in these units was placed upon basic

military indoctrination, marksmanship, and defensive combat. On-the-job experience, such as patrol of towns in the vicinity of the Military Police Center, was part of the training program.[77]

In addition to the ordnance personnel assigned to the ground elements of combat groups, several types of units were trained for third and fourth echelon ordnance activities. As part of a move to concentrate responsibility for all third and fourth echelon supply and maintenance, in June 1942 the ASC was given jurisdiction over all AAF ordnance units in the continental United States. An extensive ordnance training program was established within the command, but it was handicapped by the dispersal of the units over a wide area. Shortage of qualified commissioned personnel to staff ordnance units was a further difficulty; in order to overcome these problems, ASC made full use of facilities offered by the Ordnance Department. Units were sent whenever possible to the Ordnance unit-training centers at Flora, Mississippi, and Arcadia, California. After completing their unit indoctrination, those organizations which were to form parts of service and depot groups were returned to ASC for combined training and other organizations were normally sent direct to ports of embarkation.[78]

The problems in training quartermaster units were similar to those of ordnance, except that no centralized unit-training center was ever established for quartermaster activities either by ASF or AAF. The units, the majority of which were under ASC's jurisdiction, were stationed on bases throughout the United States. Most important of the numerous types of units trained were the quartermaster truck companies, service group companies, and air depot group platoons. These units, after four to six weeks of technical training under the various domestic air forces and commands, were assigned to the ASC for combined training as components of maintenance groups. Units which remained in the domestic air forces to perform base services were, chiefly, quartermaster truck companies and quartermaster transportation platoons. Cadres for these organizations were generally selected from graduates of AAF motor vehicle-operator schools and were then assigned to a base for on-the-job unit training and duty.[79]

Signal Corps units performed a wide variety of tasks for the air arm. They were responsible for the supply, installation, maintenance, and salvage of Signal Corps equipment; in addition, signal units constructed and repaired the long lines of wire communications between

air installations. A considerable number of special-purpose organizations were trained by the First, Third, and Fourth Air Forces; but since most AAF signal units were ultimately incorporated into service or depot groups, signal unit training was primarily ASC's responsibility. In January 1944 the ASC concentrated its signal instruction at three unit-training centers, located at Warner Robins, Georgia; Fresno, California; and San Antonio, Texas. In training signal companies for service or depot groups, a distinction was made between technical and nontechnical personnel. The latter, who included clerks, message center and supply personnel, as well as telephone, teletype, and motor vehicle operators, were trained almost entirely by ASC. The technical personnel, with specialties peculiar to the Signal Corps, were graduates of the Signal Corps schools, factory schools, or other special courses of instruction. During the unit-training period the signal companies were divided into technical and nontechnical sections and given individual refresher instruction as well as section and company training. The final indoctrination phases were not scheduled until after the companies joined their groups for combined exercises.[80]

The principal communications project of the First Air Force was the organization and training of signal construction battalions. The Eastern Signal Aviation Unit Training Center was organized at Langley Field, Virginia, for the purpose of conducting the program; it functioned during 1943 and produced eleven battalions, composed of Negro enlisted personnel. These units were trained to erect all types of wire lines, including open wire circuits, heavy pole lines, underground cables, and field wires. Instruction was divided into four phases: basic military, specialist, administrative, and unit operations. The time needed to complete these phases, fifteen to twenty-four weeks, depended upon the training state of the personnel in each organization. In addition to the signal construction battalions, the First Air Force trained a considerable number of special-purpose communications squadrons and signal aircraft warning units for domestic and overseas assignment.[81]

The responsibility for the training of aircraft warning units, however, belonged chiefly to the Third Air Force's Aircraft Warning Unit Training Center (AWUTC) at Drew Field, Florida. The primary mission of the Center was to organize, train, equip, and prepare aircraft warning units for service in combat theaters. During

the first sixteen months of the war the AWUTC attempted to train men in practically every kind of specialty used by aircraft warning units. Thereafter, by direction of AAF Headquarters all specialty courses at the Center common to other types of units, with the exception of those for radio operators, were discontinued and the AWUTC concentrated its efforts toward training those specialists for which it was the sole source of supply: radar operators; military ground observers; aircraft warning draftsmen; and information center personnel, which included plotters, tellers, filterers, and raid clerks. Training efficiency was greatly improved by a reorganization in July 1943, under which the system of training by stages or phases was dissolved and training battalion commanders were made responsible for given units from activation to shipment. During its three years of existence, the AWUTC shipped out 190 aircraft warning units, which included approximately 2,400 officers and 42,000 enlisted men; in addition, many thousands of individuals were shipped as casuals.[82]

Extensive training of signal personnel was conducted also by the Fourth Air Force, which set up a center at Camp Pinedale, Fresno, California. In March 1943 the establishment was redesignated the Western Signal Aviation Unit Training Center, and by the end of the war it had absorbed practically all signal unit-training activities in the continental United States. Thirty different types of signal and communications units were trained at Fresno during the war period. The organization of the center changed frequently. Eventually, however, it was stabilized by division into two parts: one conducted specialist schools, and the other was responsible for organizing, training, and equipping signal aviation units. There was, of course, close cooperation between the two divisions, because most of the personnel attending specialist schools were subsequently assigned to units. The unit phase consisted of team and section training at the center, field practice in the vicinity, and final exercises in isolated spots of the nearby Sierra Nevada mountains.[83]

The Fourth Air Force also gave special attention to the training of radio intelligence and fighter control units. Signal radio intelligence companies or mobile radio squadrons were assigned one to an air force; their function was to intercept and analyze enemy radio traffic, operate radio direction finders, and monitor friendly traffic. Training

normally required about thirteen weeks, divided between the team and refresher phase and the simulated combat phase. Since the units performed a large number of highly specialized tasks, a great variety of preliminary individual instruction, embracing administration and tactics as well as technical subjects, was necessary during the first phase. After the component teams completed the first phase of the program, they were combined into a company or squadron, which undertook a simulated field problem.[84]

Until April 1944, when IV Fighter Command with its component air defense wings and squadrons was deactivated, fighter control training was a function of the operating control units, which provided cadres for newly activated squadrons and supervised their training. Qualified technicians were procured from the AAF Fighter Command School at Orlando, Florida, and from radio schools of the Technical Training Command. The squadrons established schools for individual refresher training of their specialists, but most learning was a product of on-the-job experience. With the disbandment of IV Fighter Command, responsibility for training fighter control units was given to the Western Signal Aviation Unit Training Center. Indoctrination thereafter consisted almost exclusively of field operational exercises, in which fighter control squadrons joined with other units in defending specific installations against mock air raids. Each squadron was required to engage in such maneuvers for a period of at least six weeks. Beginning in the spring of 1945, when fighter control units were augmented to include radar teams, supplementary instruction on electronic equipment was also provided at the signal center.[85]

There is no doubt that AAF officers sometimes showed bias in dealing with the other arms and services under their command. Discrimination did not apply to such basic personal needs as food, housing, recreation, or mail, but it was present in the allocation of personnel and equipment. Resentment in service units was a natural reaction to such treatment, and the feeling was aggravated by the fact that training schedules were unpredictable and AAF supervisory personnel frequently lacked understanding of the policies and problems peculiar to a given arm or service. By the year 1944 many of the difficulties were smoothed out, and in spite of all handicaps the ASWAAF units effectively performed their duties at home and overseas.[86]

Service and Depot Group Training

The bulk of service units in the AAF were incorporated into service and depot groups for performance of supply and maintenance duties. The groups operated under a unified logistical system, placed in effect by the AAF after long experimentation and planning. The logistical system was outlined in AAF Regulation 65-1, dated 14 August 1942, and remained in force until the closing days of the war. Under the regulation, combat groups were considered self-supporting units, and as such were responsible for first and second echelons of supply and maintenance. The training of the ground elements of combat groups and of airdrome squadrons has already been discussed. Third echelon supply and maintenance were delegated to the service group, including its associated arms and services; the function of the service group was to furnish supplies directly to squadron airdromes and to perform repair and salvage operations beyond the capabilities of the second echelon. Fourth echelon activities were reserved for the air depot group, which operated in the rear of and in support of one or more service groups. While training and work on the first and second echelon levels were under supervision of the numbered air forces, service and depot groups were placed under the Air Service Command or its equivalent overseas.[87]

The major problem faced by the ASC in carrying out its training function was the conflict with its other responsibilities. The command was charged with providing supply and maintenance, as well as training, and its leaders were inclined to regard the former as their primary obligation. In the depots and subdepots actual repair work, or production, was normally given priority over the training of maintenance units. The problem was aggravated by the fact that the majority of service units, especially third echelon units, were compelled to train at bases under jurisdiction of the continental air forces. This was necessary because the service units had no aircraft of their own, and they consequently were forced to locate on air force bases in order to have aircraft and equipment with which to work. Air force commanders were even less concerned with the training of maintenance personnel than were ASC leaders. Interested primarily in their own flying training programs and demanding the maximum number of serviceable airplanes at all times, the air force commanders wanted the most efficient service possible—an attitude not compatible

with giving any substantial portion of work to trainee maintenance units.

Only on one condition would the air forces allow groups in training to perform their repair work, and that condition was the establishment of parent groups as permanent parties at air force stations, and from 1942 to 1945 this parent system was the basis for training service groups.

Ordinarily a parent group, made up of skilled personnel, was stationed at an air force base to service an operational training unit engaged in flying maneuvers; a trainee group was stationed at the same base from one to three months to observe the activities of the permanent unit. Many ASC officers considered this arrangement wasteful of manpower and lacking in unified responsibility for training, and they thought it would have been more economical to establish small training teams to direct and supervise the instruction of trainee service groups. Various plans and efforts to modify the parent system were unsuccessful until the early months of 1945. At that time the proposed training teams supplanted the parent system, and shortly thereafter the Air Technical Service Command, successor to ASC, turned over to the air forces complete responsibility for training all third echelon units, including the service groups. The problem of instructing air depot groups was somewhat different. Because of the nature of fourth-echelon work, the depot groups could not be trained at air force bases; they had to be trained almost exclusively at air depots. Essentially, the problem was administrative, one of arranging for special schools and courses, and utilizing equipment in such a manner as to cause the least interference with operational commitments of the depots.[88]

Soon after Maj. Gen. Walter H. Frank assumed control of ASC in November 1942, a broad administrative reorganization was initiated. On 1 February 1943 the four air service area commands, each of which had exercised considerable latitude in governing its own training activities, were supplanted by eleven air depot control areas. With this increase in the number of subordinate jurisdictions, it became more than ever necessary to develop a unified training program which would standardize procedures throughout the ASC. The development of a comprehensive plan for such standardization was largely the work of Col. Dwight B. Schannep, chief of the ASC Training and Operations Section; this plan, after approval by General Arnold, was

published as a directive to all area commanders on 1 June 1943. It provided for three phases of instruction, each located at a specified station, for both service and depot groups.[89]

Although details of the schedule for training differed for service and depot groups, the general outline was similar. The conventional schedule for a service group during 1944 may therefore be considered as typical of both types of units. The time allowed for the training of a service group from O-day until the organization was shipped to a port of embarkation was about six months. O-day for any group was the date when a stipulated percentage—which fluctuated from 85 to 115 per cent—of its T/O strength was reached. The six-month period did not include instruction received between A-day, the date of unit activation, and O-day; neither did it include pre-activation training of cadres. The time between A-day and O-day depended upon how rapidly the unit received its personnel; the period of cadre training varied from thirty to ninety days.

During the first phase, or activation period, the principal operations of the unit were receiving, processing, and assigning personnel. These activities were directed by the cadre, which also planned and supervised the basic and technical instruction required by the incoming men in order to qualify them for duties in the various sections of the group. After O-day the second phase, unit training, was started for the squadrons which were already attached to the group headquarters. These units were the headquarters and headquarters squadron and two service squadrons. The ASWAAF units were trained separately and did not usually join the group until the third phase, when combined training began. ASWAAF elements included one aviation quartermaster company service group, two aviation quartermaster truck companies, two aviation ordnance supply and maintenance companies, and one signal company service group. The total strength of the service group was over 1,000 officers and men. While the unit training of AAF elements of the group lasted two months, combined training required about four months. During this time, under surveillance of a parent group, the component units were molded into a functioning, integrated organization. Toward the end of this stage, the trainee group acted as much as possible on its own, operating under simulated combat conditions and preparing for overseas movement.[90]

Although the general plan for training service and depot groups called for the accomplishment of certain instructional phases at given

stages of the schedule, there was actually a great deal of overlapping.[91] Basic military training, for example, was not restricted to the early stages. Nearly all enlisted personnel assigned to the groups had received previous instruction of this type at Army reception centers or at AAF basic training centers, but it was necessary for ASC to provide additional training where deficiencies were discovered and for the purpose of maintaining proficiency. Because of the nature of the work to be performed by ASC units overseas, many aspects of basic training received less emphasis than in other elements of the air or ground forces. Extended order drill, hand-to-hand fighting, and jungle warfare, for example, were given slight attention; on the other hand, subjects such as camouflage, safeguarding information, desert operations, and operations in extreme cold were covered in detail.

Individual technical training was the foundation of the air service unit program. Normally, the individual received basic technical instruction before assignment to the unit, but the instruction might have to be completed after this. Some advanced technical training was provided by means of sending individuals to specialized schools of the AAF or other branches and to factory and contract schools. Since, however, quotas for schools were relatively small, most advanced technical instruction was received by individuals in the course of unit and combined training. In some cases this instruction was conducted in shops and schools of the air depots where the trainees were given on-the-job practice, supplemented by classroom work.

Time was so short that theoretical instruction was generally held to a minimum, and cross-training in related subjects was deferred until the latter portion of the program. Technical instruction within the units was usually accomplished by dividing the classes according to the members' occupational specialties. In some cases the more experienced trainees served as instructors for each class; wherever possible, the courses were supervised by officers or high-ranking enlisted men. After individuals were considered proficient in their particular specialty, they were trained in as many related skills as time would permit. This practice made for greater flexibility within the unit and, incidentally, for higher morale among the men.

Individual instruction was continued as a part of unit training, but the objective of this phase was the welding of individuals into a working team. Fulfillment of this aim necessitated explanation of the or-

ganization and functions of the group and its interrelated components, training in administrative and supply procedures, practice in unit security and defense against various forms of attack, and instruction in movement operations. Combined training, considered the final phase in preparing a new group for action, was often started in conjunction with unit training; the two phases were closely meshed. The purpose of combined training was to weld the component units, including ASWAAF elements, into a functioning group. Such instruction was conducted preferably at locations where repairs on aircraft could be accomplished simultaneously with simulated field maneuvers. During this last stage the group operated under the supervision of key personnel from a parent unit, after a considerable period of observing the activities of the parent group.

The most persistent difficulty in connection with combined training, as noted previously, was finding repair work for the new group to perform. In some instances the activity amounted to little more than a dry run, a sham exercise in which personnel went through the motions but received no actual practice. General Frank protested to AAF Headquarters in February 1943 on the inability of the domestic air forces to establish and maintain operational programs which afforded proper training to service groups under field conditions. Some improvement in the situation was brought about by organizational changes, but the problem was never completely solved.

Some modifications of the over-all training program for service units were brought about by the development in 1944 of a new-type service group to replace the established old-type unit. The old-style group was designed to operate a service center overseas in close support of two combat groups; the squadrons composing the service group were usually dispersed as a precaution against enemy attack. This type of organization originated in the early period of the war when the Allied forces were on the defensive and the enemy enjoyed air superiority. But as the situation changed during the war, the necessity of dispersing aircraft and installations gradually disappeared. Field experience, moreover, had demonstrated by 1944 that the service groups based on the same fields as combat groups should be able to provide regular base services so that combat units could concentrate upon their primary mission. Because of these considerations, which applied with special force to B-29 units, the new-type service group was developed. It was designed to provide third echelon supply and

maintenance for one combat group and in addition to supply fire-fighting and other station-complement services. The new groups were also streamlined internally in order to improve administrative efficiency; members of other arms and services were absorbed with AAF personnel in the three squadrons which composed the group: headquarters and base services (administrative), materiel (supply), and engineering (maintenance). The new type consisted of 41 officers and 617 enlisted men, compared with 68 officers and 1,113 enlisted men in the T/O of the old-type group. The new unit was designed to service only one, instead of two, combat groups, but it also performed important base services. Individual and unit training of ASWAAF personnel were not affected by the organizational change; when those units joined the AAF elements of the new-type group for combined training, they were simply incorporated as appropriate sections of the three component squadrons.[92]

The final significant change affecting service groups occurred in May 1945, when responsibility for their training was transferred from the Air Technical Service Command to the Continental Air Forces. The CAF, which included the four domestic air forces and I Troop Carrier Command, was not prepared to assume this responsibility at the time the change was directed, but steps were taken at once to transfer needed personnel and equipment to CAF from ATSC. The shift of responsibility was in conformity with the trend toward integration of combat and service units in the AAF. In view of the impediments to training which had arisen from dual command during the war, it became clear that combat and service units could be trained as a team most successfully under single command responsibility. The training of air depot groups remained a function of the ATSC.[93]

A large number of special units were trained in the course of the war, over and above the production of regular service organizations. One of the most interesting was the floating aircraft maintenance unit, which was developed as a part of the Army aircraft repair ship project. This project was conceived as an answer to the peculiar geographical conditions of the Pacific. Since repair facilities could seldom be moved forward quickly in that area by means of conventional land transportation, the AAF desired floating repair facilities which could be moved easily during campaigns and which could provide maintenance to combat aircraft until the arrival of land-based

service groups. The project involved the conversion of six 10,000-ton Liberty vessels for service as repair ships, as well as eighteen smaller auxiliary vessels. Each ship, furnished with modern equipment and highly trained personnel, could support several combat groups, and each auxiliary was capable of servicing one group. Almost every type of repair except complete engine overhaul was performed in the shops of these vessels. The training of personnel for the floating units, which was conducted during 1943 and 1944, differed considerably from standard service-group instruction. Individuals had to be prepared to perform more than one specialty in order to insure maximum usefulness of these organizations. Final unit training was carried on in mock-ups which were replicas of shops on board the repair ships; the last stage of preparation involved a month of marine training on the vessels themselves. The floating unit program, in which the Navy and other branches of the Army cooperated, was under jurisdiction of the Mobile Air Depot, Air Service Command.[94]

CHAPTER 20

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OTHER TRAINING PROGRAMS

ALTHOUGH combat crews, with their supporting ground personnel, manned the aircraft which constituted the main striking power of the AAF, there were innumerable other elements that performed indispensable or highly useful functions. Important among these were the pilots and crews of the ferrying and transport service, who required special training. Instruction was also necessary for the legion of ground administrative officers, key staff personnel, and a considerable number of foreign nationals who were joined with the United States in common war against the Axis.

Ferry Pilots and Transport Crews

Probably no other AAF agency had to fly so many different models of aircraft as the Air Transport Command. For transport the command depended chiefly upon two models: the steady C-47 and the larger, more commodious C-54. But the original and continuing function of the organization was to provide crews for the ferrying of combat models from factories to points of transfer to specified foreign governments, to AAF bases at home, and eventually to combat areas overseas.* Although its redesignation from Air Corps Ferrying Command to Air Transport Command in June 1942 foretold the development of cargo and passenger service into the most important activity of ATC, ferrying continued to be one of its major responsibilities. In the beginning ferrying itself had been considered an aid in the training of Air Corps pilots, and the command had drawn its crews in large part from AAF pilots in need of experience on the models to be delivered. After Pearl Harbor, however, the original plan to allow

* For the origins of ATC, see Vol. I, Chap. 9. The account of ATC training is here abbreviated, since the full account of ATC will appear in Vol. VII.

pilots to transition through ferrying to an assignment with combat units had to be abandoned.[1] As a result, the Ferrying Division of ATC faced the problem of training its own crews.

The burden of training was reduced by recruiting directly from civilian life a large number of flyers, including former test pilots, stunt flyers, and barnstormers; operators of small airfields; pilots of business and pleasure craft; civilian flying instructors in contract schools; and airline pilots. Many of the civilians were subsequently commissioned as service pilots, a rating for which the physical and other qualifications were somewhat lower than those for combat duty. In 1944 service pilots in the Ferrying Division constituted about 40 per cent of the total pilots assigned; in addition, the division used a sizable group of nonmilitarized women pilots.[2] Nevertheless, the need for additional pilots and for keeping crews abreast of new and more complex aircraft models forced the Ferrying Division to give increasing attention to training.

Air transport activity developed as a service primarily to overseas areas, a service which at first was performed largely by the commercial airlines operating under contract with the AAF. By an agreement of July 1942 the airlines established an Airlines War Training Institute as a means of guaranteeing a continuing supply of crews,[3] but the number thus trained fell short of the need, and the Air Transportation Division of ATC in time had to rely on military personnel. To provide training for use of its own planes and for the special requirements of its far-flung operations, the division began operating an OTU in 1942. In the fall of 1943 the Ferrying Division assumed full responsibility for all ATC pilot training.[4]

The requirements which governed the development of training for ferry pilots grew out of the need for flyers able to handle many different aircraft models. A "crack" pilot with long experience on one or two models was not so useful as the man who could fly fifteen or twenty different planes. It was necessary, therefore, to provide transition instruction on many planes, in the hope that pilots could qualify on all major U.S. models. A transition school had been established at the Long Beach ferrying base in California as early as July 1941; others were set up in the spring of 1942 at Seattle, Nashville, Detroit, Baltimore, and at Hensley Field in Texas.[5] Additional transition training was provided as occasion permitted in the several ferrying groups, which were the basic organizational units for ferrying personnel and

which were supposed to provide continuous ground-school instruction in navigation, aircraft identification, armament, meteorology, and other required subjects. The level of conformity with this requirement seems to have been low until the later half of 1943, when supervision by ATC headquarters was tightened.[6] Under the pressures of the early days, transition might have involved no more than a ten-minute talk about the plane and an hour or two of flying.[7] This had often done well enough for reasonably experienced pilots, but as the experience level of incoming pilots declined, it became necessary for ATC to establish increasingly rigid standards.[8] Until the end of 1943 the necessity of depending for training purposes chiefly upon planes in the ferrying "pipeline" made difficult both the maintenance of high standards and of efficient training schedules.[9]

Early ferrying operations had suffered from a lack of equipment and training for night flying. Formal instrument instruction at ferrying stations did not begin until April 1942, when a special school was established at the Long Beach base, with four Link trainers and a staff of two officers. By July the organization had developed a three-phase program of Link, ground, and flight instruction. Other stations followed the lead of Long Beach in providing instrument courses, and in January 1943 the Ferrying Division prescribed a standard pattern for this kind of training. An indication of the progress made by the division in its instrument program is found in the fact that while only 300 instrument qualification cards were issued to ferry pilots during 1942, nearly 3,000 were issued in 1943.[10]

When the Ferrying Division assumed responsibility for all ATC training in October 1943, it took over three OTU's—located at St. Joseph, Missouri; Homestead, Florida; and Reno, Nevada. A newly developed training program called for an integration of the formerly distinct programs for ferry and transport pilots. Pilots were to be moved by way of the ferrying groups, where their training would provide transition from the smaller to the larger types, into the operational training units. It was expected that the entire sequence would require from twelve to eighteen months for each flyer, at the end of which time he would be a fully qualified transport pilot. The plan called for monthly assignments to the Ferrying Division of specified numbers of pilots, navigators, radio operators, and aerial engineers, and the output of 150 to 200 crews per month.[11]

In the spring of 1944 directives for ground courses were revised to

provide a clearer statement of objectives and a more exact definition of standards, and in June of that year a completely new plan of study was initiated. Instruction, to be given largely by the groups, was divided into seven stages, each of them designed to furnish the transition training needed by individuals in a given pilot classification. All subjects were limited to a few hours in length, so that pilots could complete at least one of them in a day and thus take advantage of short intervals between missions. The final Stage G prepared for overseas operations through instruction in the recognition of Allied and enemy aircraft, interrogation of prisoners, survival, camouflage, and swimming.[12] The chief improvement in flight transition training resulted from the increased number of permanently assigned aircraft. The Ferrying Division had possessed in its own right something less than 300 planes of all types on 1 October 1943, but by 1 August 1944 the number had risen to over 800. Marked improvements also came in the time given to night and instrument flying. In addition to establishing a specialized instrument course at St. Joseph for pilots of AT-17's and C-47's, the division increased the requirements for regular instrument training within the ferrying groups. More flying in bad weather and at night was urged, with due allowance for safety considerations, and more instrument training was given while pilots were on regular ferrying missions. By June 1944 the groups were well ahead of their assigned quotas in issuing instrument proficiency cards.[13]

By January 1944 the 1st OTU, at St. Joseph, was serving as a specialized instrument training school. The 2d OTU, at Homestead, was a four-engine transport school, while the 3d OTU, at Reno, specialized in training for China-India operations. Specialized fighter transition training, which had started at Palm Springs, California, in November 1943, was moved in the spring of 1944 to Brownsville, Texas, where the new school was designated the 4th OTU. Although the 2d and 3d OTU's conducted full transport crew training, graduation of students was on an individual, rather than crew, basis. This arrangement speeded production of qualified graduates. Pilots who proved unsuccessful in the OTU's were normally assigned as co-pilots in ATC's overseas divisions.[14]

The curriculum at the 2d OTU was devoted to C-87's and C-54's and covered a thirty-day period, divided into fifteen days of ground and fifteen days of flight training. The former consisted of a concen-

trated study of subjects such as aircraft engineering, cruise control, weight and balance, celestial navigation, and meteorology. Flying instruction consisted mainly of advanced instrument work and included a final cross-country operation as well as local flights. The 3d OTU, which trained crews specifically for the arduous Hump operation over the Himalayas from India to China, had a more difficult training mission than the 2d, and it was found necessary to extend its instructional period from four weeks to six. Special emphasis had to be placed on selecting for this training pilots who had considerable multi-engine and instrument experience.[15]

The WASPS

Although use of women flyers in the event of a national emergency had been considered as early as 1939, it was not until almost a full year after Pearl Harbor that anything was done. There were many reasons for the delay, but the basic one was a fundamental disagreement on the scope of the program. When the Air Transport Command created the Women's Auxiliary Ferrying Squadron in September 1942, it appointed Mrs. Nancy H. Love as commander. Mrs. Love advocated a policy of accepting only those women flyers who were exceptionally well qualified, and this concept had the support of ATC's Ferrying Division, for which the women were to fly. But about the same time that Mrs. Love was appointed, Miss Jacqueline Cochran was made Director of Women's Flying Training at AAF Headquarters and was given the mission of supervising the procurement and training of qualified women pilots for assignment to ATC. Miss Cochran had in mind a more ambitious project for the women—she pressed for the formation of a relatively large corps (under military or quasi-military discipline) and for the ultimate assignment of women to a variety of jobs besides ferrying.[16] General Arnold, too, thought that women could be used fairly extensively. In November 1942 he directed the Flying Training Command to consider instruction even for women with no previous flying experience; he thought that the fullest possible employment of women for noncombatant duties was necessary in order to release qualified men for duty overseas.[17]

A small group of experienced women flyers began training in November 1942 at Houston, Texas. The instruction was given by a contract flying school, under jurisdiction of the Gulf Coast Training

Center. When facilities at Houston proved too limited early in 1943, the program was moved to Avenger Field at Sweetwater, Texas. The first curriculum provided for a four-month course, designed to qualify the women pilots "to ferry training type Army Aircraft." Although the hours specified were flexible and varied according to previous training, 115 hours of flying were generally called for in addition to 180 hours of ground instruction. As the experience level of the women trainees declined, the course was expanded and revised. By the close of 1943 the length had been extended to twenty-seven weeks. Flying training, which was divided into the conventional phases of primary, basic, and advanced, took up 210 hours. Prescribed ground subjects consisted chiefly of elementary mathematics and physics, navigation, radio code, aircraft and engines, weather, and aeronautical equipment maintenance. During 1944, in anticipation of the proposed militarization of the Women Airforce Service Pilots (WASP), instruction in military subjects was increased. The aim of the course as a whole was to bring the women flyers up to service-pilot qualifications. In order to prepare the trainees especially for ferrying duties, navigation was emphasized, and two long-distance cross-country flights in PT-17's and AT-6's were required before graduation.[18]

Most of the graduates were assigned to ATC, although some were given additional training for other noncombatant duties. A small number, chosen to become tow pilots in glider or gunnery schools, received special transition training on the C-60. The women experienced difficulty in this particular type of training because they generally lacked sufficient "strength and stamina." Transition training in B-26 aircraft, on the other hand, was a "reasonably successful experiment." In July 1944 an instrument flying course was established at Sweetwater to qualify women pilots for standard instrument ratings, so that they might become instrument instructors. The curriculum, which included some fifty hours of instrument flying on the BT-13, in addition to ground-school subjects, was given for a period of several months. It was discontinued in November 1944 because of the imminent deactivation of the WASP program, but by that time 232 women had successfully finished the course. That number represented about 95 per cent of all those who were given instrument training.[19]

When the pilots of the Women's Auxiliary Ferrying Squadron began to deliver airplanes for the ATC, their activities were limited almost entirely to training and liaison aircraft. During 1943 and 1944

these restrictions were eased, and women pilots were given transition on high-powered types under the same standards of experience and by the same methods as applied to male pilots. The number of women pilots assigned to the Ferrying Division reached its peak of 303 in April 1944. But by the time they were ready to replace a substantial number of men, in keeping with the original purpose of their organization, victories overseas brought a reduction in military requirements for pilots. Toward the end of 1944 the Women Airforce Service Pilots were accordingly disbanded.[20]

Training of Administrative Officers

Although the AAF during the war concentrated its training effort upon flying and technical personnel, it could not ignore the need for qualified administrative officers. When rapid expansion of the air arm began in 1940, the small number of officers assigned to the Air Corps was a serious limitation. Furthermore, the need for qualified rated personnel to perform necessary flying was so critical that the AAF sought to relieve rated officers of nonflying duties wherever possible. This policy could be effected only through procuring and training large numbers of young men for multifarious administrative assignments.

In February 1942 General Arnold directed the head of the Technical Training Command, Maj. Gen. Walter R. Weaver, to establish an AAF officer candidate school (OCS) at a location of his own choosing. In response to the demand for speedy action, General Weaver went at once to Miami Beach, Florida, and personally supervised the establishment there of the new organization. It remained at Miami Beach until June 1944, when it was transferred to the San Antonio Aviation Cadet Center, Texas. In June 1945, only two months before it was suspended, the school was moved to Maxwell Field, Alabama. During the wartime period nearly 30,000 men were graduated from the school.[21]

Officer candidates were selected from two main categories of personnel. Former aviation cadets, eliminated for flying or physical deficiency, had first priority in assignment to OCS, provided they were recommended for officer training by their commandants. Warrant officers and enlisted men made up the second group. The qualifications for their selection established in February 1942 included age limits of 18 to 36 years, American citizenship, demonstrated capacity

for leadership, physical condition as required for commissioned officers of the Army of the United States, a score of 110 or higher on the Army general classification test, and "such education or practical experience as will reasonably insure . . . satisfactory completion of the course of instruction." These requirements remained in effect without important modification until after V-E Day. In June 1945 steps were taken toward restricting selection of candidates to individuals who waived discharge privileges under the current demobilization program.[22]

The number of men eligible for OCS was greatly in excess of the quotas. Judicious selection of the applicants, a task assigned to local officer candidate examining boards, was both important and difficult. The criteria which guided the selection process of these boards varied to a considerable extent, and the laxness of some boards was criticized from the beginning. On the other hand, qualified men were often denied the opportunity to receive officer training because of the disposition at some posts and stations to discourage applications by those who were serving usefully in assigned enlisted duties. Higher authority was aware of this practice and repeatedly cautioned against such discrimination as contrary to the best interests of the service.[23]

Twelve weeks was the standard length of the OCS course until June 1943, at which time it was extended to sixteen weeks. The academic curriculum until January 1943 was uniform for all candidates and was presented under five headings: administration, mess, supply, transportation, and miscellaneous. In January the curriculum was divided into two phases. During the first eight weeks students were instructed in the general duties of the junior officer; for the rest of the training period candidates were assigned to one of the following specialized programs: adjutant and personnel, supply, mess, intelligence, guard company, and training. Graduates could not always be assigned according to their OCS classification, but specialization gave more point to the curriculum than it previously had. This system continued without major alteration until October 1944, when the greatly reduced size of entering classes made specialization impracticable. Most of the instruction was conducted in classrooms, but near the end of the course the students took part in a ten-day bivouac, called field service, in which they simulated the defense of an airfield.[24]

In the specialized phase of the program the emphasis fell sufficiently on practical questions to command the student's attention, but the

earlier part of the program suffered from many faults. It was overloaded, with never less than twenty-five separate subjects required of all students. The whole was poorly integrated and, in the effort to be detailed in coverage, was nevertheless superficial. The majority of the instructors, many of whom were recent OCS graduates, had no teaching experience and frequently did not conceal distaste for their assignments. In many cases the teacher did little more than review with the class the contents of mimeographed subject outlines issued to the students. To pass the courses, it was necessary only to memorize the outlines and cram for the tests. Some efforts were made to remedy the situation by more careful selection of instructors and by improvement of course outlines and teaching aids. Early in 1943, in keeping with a directive requiring "practical" instruction throughout the Technical Training Command, lectures were ordered abolished, but this move merely turned a bad situation into a chaotic one, and the directive was subsequently modified. The principal purpose of the academic program as given seems to have been to keep the candidate under a pressure designed to test his ability to comply with a variety of exacting requirements.[25]

The dominant role in OCS was played by the Department of Military Training. Its director, who also served as commanding officer of the Corps of Air Corps Officer Candidates, was assisted by a staff of supervisory officers assigned to wings, groups, and squadrons of trainees. These tactical officers, and especially those assigned at the squadron level, worked closely with the officer candidates from the time of their arrival until graduation, giving their particular attention to the supervision of military drill and inspections. For the purposes of rapid indoctrination in the military way of life, the "class system" had been borrowed from West Point. Student officers were chosen from the upper class, and the whole body of upperclassmen was charged to keep new students under pressure and to see that they rigidly observed prescribed rules of behavior. The methods employed were time-honored and familiar to most Americans through Hollywood versions of West Point life: the enforced recitation of regulations, posture "bracing," and other modified forms of hazing, which officially was banned.[26] However well suited to the development of a professional soldier this system might be, it was abused in OCS and was at best of debatable utility for the training of a citizen soldier.

Enforcement of regulations was carried out primarily through a

demerit system. Candidates were "gigged" for individual deficiencies, and demerits were assessed by the squadron commander according to a more or less standard scale. Accumulation of more than the maximum number of demerits allowable for a single week resulted in punishment "tours" (i.e., walking post) during week-end pass time. Deficiencies of this kind were sharply distinguished from breaches of the honor code. Candidates accused of cheating on examinations or of other violations of the military code of honor were judged by a student honor council. Individuals found guilty, after final review by the school commandant, were eliminated, reduced in grade, and reported to AAF Headquarters.[27] A negligible proportion of officer candidates was eliminated for breaches of the honor code, but there were other failures. The percentage of eliminees and resignations, however, was never so high as the rumored 10 per cent or above. The actual figure was usually well below 5 per cent. The school was sharply criticized, especially in 1942, for not culling a larger number of those unfit for commissions.[28]

Graduates of OCS provided the bulk of ground administrative officers required by the AAF, but it was also necessary to commission many thousands of men directly from civilian life. These individuals were predominantly men with business, teaching, or specialized experience; nearly all of them were from thirty to forty-five years old. The majority of these newly commissioned officers were assigned at once to particular jobs and given military indoctrination through local training programs. A substantial number, however, were assigned to a central officers' training school (OTS), established at Miami Beach soon after the activation of OCS. In June 1942 the two institutions were consolidated administratively although the programs remained separate. OTS students engaged their own accommodations at beach hotels which had reached informal agreements with AAF officials; food was perhaps the most difficult problem since the Army did not initially provide messing facilities. Not until near the close of the program was a satisfactory solution provided through establishment of a general mess. The last OTS class was graduated at Miami Beach in June 1943; training of officers commissioned directly from civilian life was thereafter decentralized to the commands and stations. By then more than 13,000 students had completed the program at OTS.[29]

The curriculum was similar to that for officer candidates during the same period, but it was only half as long. The course, uniform for all

officer trainees, included academic, military, and physical training. The chief contrast with candidate training lay in the fact that there was no class system, and outside of scheduled hours the officer students were free from squadron discipline. Physical exercise was less rigorous and was adjusted to fit the needs of the various age groups. While officer candidates were driven to stretch the limits of their physical endurance, the older officer students were cautioned against overexertion. Very few individuals were eliminated from OTS; in such cases they were reported to AAF Headquarters for ultimate disposition.

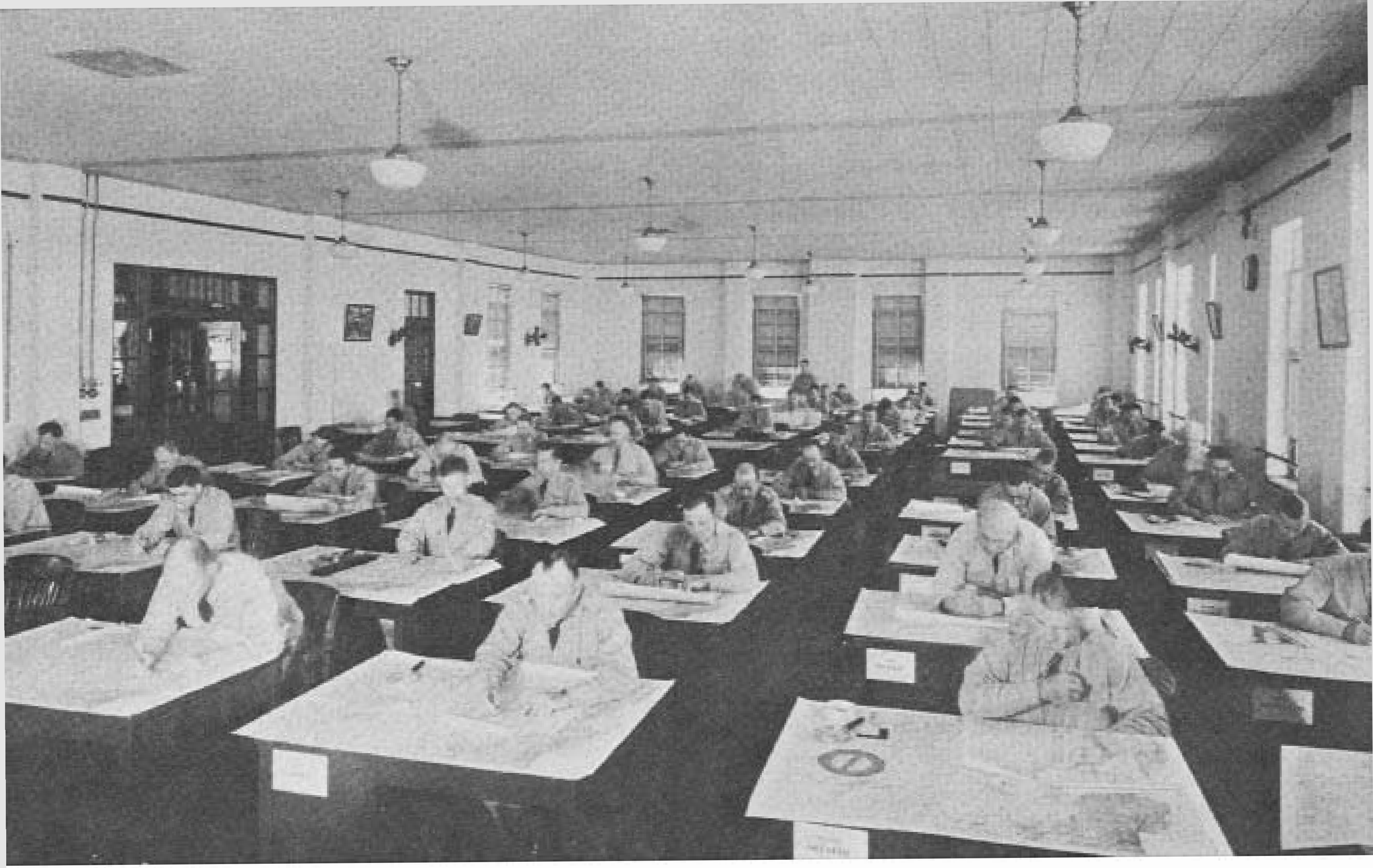
Combat Cadre and Staff Officer Training

During the war the principal center for development of air doctrines and instruction in their application was the AAF School of Applied Tactics (AAFSAT). This school was successor to the Air Corps Tactical School, which from 1931 to 1940 had operated at Maxwell Field, Alabama. Courses had been given at Maxwell to senior officers (above the age of thirty-two) in command and staff problems, air tactics and strategy, and ground tactics. When the Air Corps cadet training program was expanded during 1939 and 1940, it was necessary to transfer many instructors from the school to the new flying training establishments. This, plus the fact that few officers could be spared to attend the classes, forced suspension of the school's operations in June 1940.

By the fall of 1942, with the AAF engaged in a global war, the need for a tactical school became critical. Not only did the Air Corps lack experienced personnel to staff key positions in its projected combat groups, but there was need for an agency devoted to close study of the problems of air warfare. After prolonged consideration of the problem by AAF Headquarters, the School of Applied Tactics was activated at Orlando, Florida, in October 1942.[30] It inherited the facilities and staff of the Fighter Command School, which had been training personnel for air defense activities since early in the year.* The original organization of AAFSAT included four departments: air defense, air service, air support, and bombardment. This division paralleled the command arrangements commonly existing within the several air forces at that time; in fact, the school was designed to operate as a model air task force, its operational theater being an

* See above, p. 68.

FRENCH AVIATION CADETS, TURNER FIELD, GA.



AIR CORPS TACTICAL SCHOOL, MAXWELL FIELD, ALA.: MAP PROBLEM ROOM

8,000-square-mile zone in central and western Florida. In addition to the centrally located Orlando Air Base, the zone included numerous flying fields of various types, service depots, searchlight installations, ground observer posts, and radar stations.

During its first year of operation, the school concentrated its efforts on the training of combat cadres. After completing appropriate academic courses, the cadres were moved to satellite airfields, under jurisdiction of AAFSAT, for operational training. By the middle of 1943, when the AAF's expansion program was largely completed, the need for regular cadre training declined. AAF requirements for men trained for staff work were on the increase, however, and many specialized courses were started. A reorganization in October 1943 placed AAFSAT under the AAF Tactical Center and established a new Demonstration Air Force, which combined the tactical units assigned into an organization fully equipped for exhibition under simulated combat conditions of tactics developed by AAFSAT and approved by the AAF Board. The board, which made final recommendations regarding air doctrines and equipment, was also located at Orlando, independent of but coordinated with the Center. Brig. Gen. Hume Peabody, who had ably commanded AAFSAT from its inception, became commanding general of the Center, and Col. Harlan W. Holden, formerly executive officer, was named commandant of AAFSAT.[31]

At the end of 1944 the departments of instruction were combat operations, communications, intelligence, logistics, aeromedical, antiaircraft artillery, staff and special training, and inspection; these remained essentially unchanged until V-J Day. In March 1945 a program plans division was created for the purpose of reviewing the content of all courses, with the aim of keeping them current with tactical trends. A standards division, also created at that time, had responsibility for maintaining required levels of instructor and student performance. It included an examinations and grades section, a teacher training section, and a section devoted to preparation of syllabi and manuals.[32]

The central library, established in 1943, carried the main burden in a notably successful attempt to provide the necessary information for the guidance of teaching and research. Its 17,000 books and pamphlets represented at the close of the war an outstanding collection of military and air publications; in addition, it had some 75,000 maps and documents, and during the war hundreds of reports of various types

streamed into the library each week from the combat theaters.[33] A central school facilities department prepared training aids and provided school supplies. Elaborate and realistic mock-ups and demonstration areas were constructed for all subjects of instruction.[34] A systematic two-week training program, begun early in 1944, undertook to orient newly assigned teachers in the organization, facilities, policies, and techniques of AAFSAT, and to provide instruction and practice in educational methods. Since a large number of the officers assigned to teach at AAFSAT were experienced in combat and military affairs but lacking in pedagogical skill, this program proved valuable in raising the level of instruction.[35]

Most of the students who attended AAFSAT came on temporary duty orders from their own organization under quotas established by AAF Headquarters for the subordinate commands. Experience showed this to be the best procedure, for when assignment involved a permanent transfer, command headquarters tended too often to fill its quota with men who seemed to be the least useful members of the organization. Although there were some instances of malassignment, the school received exceptionally able individuals, especially in the higher grades. The percentage of eliminees, except in one or two courses, was exceedingly low. The total number of graduates from AAFSAT from November 1942 to V-J Day amounted to almost 54,000. About two-thirds of the total were Air Corps personnel; most of the remainder ASWAAF personnel, and a small number were foreign nationals, officers of the U.S. Navy, or members of the WASP. Every rank in the Army up through major general was represented, although company grade officers predominated. Enlisted personnel constituted about one-quarter of the total number of graduates. Part of the value of the students' experience at AAFSAT lay in the relative freedom from rigid discipline and the easy association among men of varied military experience.[36]

The subjects taught ranged over the varied fields of AAF activity and reflected particular needs of the moment. As previously indicated, the school was at first designed to overcome the disadvantages of using inexperienced personnel in command and staff positions. To accomplish this end, key personnel from newly activated combat groups were sent to AAFSAT for approximately thirty days of classroom and field training. After 1943 this cadre training was given chiefly for B-29 units. Lectures were modified and augmented to suit

the new requirements, and an impressive quantity of training aids was quickly produced by the school to demonstrate key features of B-29 equipment. The first B-29 class started academic instruction in April 1944. Field maneuvers, following the established pattern, consisted primarily of flying simulated combat missions. Specific targets were ordered destroyed, and the group commanders assumed responsibility for planning and executing the missions. Fighter escort and interception were provided for as many missions as possible, and photographic methods were used for scoring the simulated bombing runs.[37] In addition to cadre training, the school offered numerous special courses in combat operations. It had played a vital role in the introduction into the AAF of the doctrines and tactics of ground-controlled interception, which the RAF had used so brilliantly in the Battle of Britain.* As this suggests, training in the uses of modern communications devices was first geared to the needs of a defensive type of operation, but with the progress of the war the emphasis shifted to their offensive employment. Other specialized courses included one offered for staff weather officers—a course which explored the general applications of meteorology to air and ground combat.[38] Another directed attention to flak analysis in a search for means to reduce aircraft losses from enemy ground fire.[39]

In April 1944 Orlando also became the center for training in air intelligence. Before Pearl Harbor there had been no real provision for formal training in this field. Small quotas had been allotted to the Air Corps for attendance of its officers at the Command and General Staff School at Fort Leavenworth, Kansas, and the Engineer School at Fort Belvoir, Virginia. But the G-2 course at Fort Leavenworth stressed the training of staff officers for infantry divisions, and the Fort Belvoir curriculum was presented from the point of view of the Corps of Engineers. After lengthy agitation by the AAF, approval was finally granted in January 1942 for establishment of an air intelligence school. Instruction began in space provided by the University of Maryland, but in April the school moved to government-purchased property at Harrisburg, Pennsylvania. Col. Egmont F. Koenig, formerly an intelligence officer of the ground forces, was named commandant, and since no detailed training directive was issued, the curriculum was largely his work. The original course gave primary emphasis to photographic interpretation, and as more information be-

* See above, pp. 93–95.

came available concerning the nature of air combat intelligence, that subject received even more attention. In September 1942 classes were started to prepare students for prisoner-of-war interrogation, but the number of officers assigned to such training was never large.[40]

The course in photo intelligence, as developed at Harrisburg, taught technical fundamentals as well as the general duties of an air intelligence officer. It aimed to provide the foundation for further indoctrination and practice in the theater, but was handicapped by inadequate reporting of developments from overseas. The eight-week course was given in segments, each one dealing with a particular phase of intelligence interpretation; principal stress was placed upon identification of all types of objects as seen in aerial photographs.[41] Increasingly, the emphasis in the school fell on a combat intelligence course designed to train men as squadron and group S-2's. The tasks identified with this essentially new and rapidly developing field of military intelligence are suggested by the topics with which the course was mainly concerned: target information, briefing, and crew interrogation; techniques of aircraft, naval, and ground vehicle recognition; organization and administration of the S-2 section; and basic map and chart reading. Since it had been found that the graduates on arriving overseas were frequently not given the scope of authority and responsibility which they had anticipated, greater attention was given to the numerous minor tasks that had to be performed in a typical S-2 office. The original basis for selection of officers for assignment to combat intelligence training did not prove entirely satisfactory. In the belief, buttressed by RAF experience, that the men best suited for this type of work were middle-aged, nonrated officers with professional backgrounds, large numbers of older men were commissioned directly and given intelligence training. But in the theaters of combat many of these officers found difficulty in understanding the feelings and attitudes of the younger crew members. They were handicapped by lack of flying experience and occasionally revealed ignorance of facts which appeared obvious to airmen. The men who generally did the most effective job were thirty-five years of age or younger and had varied interests. Former advertising men, social workers, and others accustomed to meeting and dealing with all types of people showed an adaptability which helped them to gain the confidence of individual crew members. Human understanding and sensitivity were important requisites, regardless of the individual's background.[42]

In March 1943 the Air Intelligence School assumed responsibility for a course in air base intelligence which had originated at Camp Mabry, Austin, Texas. The curriculum, which aimed to prepare students for duty as base intelligence officers, remained fairly constant. It included such subjects as espionage and counterespionage, sabotage, investigations and reports, relations between military and civil courts, and the use of troops in civil emergencies. Most of the graduates of the course were assigned to posts in the United States, only a small number being requested by the overseas theaters.[43]

Before the removal of the Air Intelligence School from Harrisburg to Orlando, intelligence training by AAFSAT had been limited to what was included in its cadre training programs. Since intelligence officers of the cadres were usually graduates of Harrisburg and enlisted personnel assigned to S-2 had graduated from an enlisted men's intelligence school at Salt Lake City, instruction at AAFSAT had stressed the practical application of knowledge acquired through earlier studies. After April 1944 the standard courses developed at Harrisburg were henceforth taught at AAFSAT, with little fundamental change. A few specialized courses were added in time, such as that on radarscope photographic interpretation for very-long-range reconnaissance units.[44] At the same time, AAFSAT's earlier cadre intelligence program was in a sense continued through a staff intelligence officers' course which gave training for positions up to and including the combat wing level. In February 1945 AAF Headquarters directed that a senior intelligence officers' course be established. Emphasis in this program, placed at the level of major commands and above, was on broad intelligence planning and policy-making. It included discussions of economic warfare, political intelligence, signal intelligence, and liaison with air forces of Allied powers. Only officers of field grade with experience in combat and in a high headquarters intelligence section were eligible for the course. It was taught by a combination of lectures, demonstrations, and conferences.[45]

While intelligence training at AAFSAT was restricted to a relatively small portion of the total student body, more than 90 per cent of the school's graduates received some form of medical instruction. The instruction for nonmedical personnel was considered of equal importance with the special training offered for doctors, so that all types of personnel would get an understanding of the importance of

maintaining high medical standards in their units. It was believed that commanders and staff officers, especially, should develop a cooperative attitude toward the surgeon and his work. Courses gave instruction in the use of emergency equipment by combat crewmen, the care and wearing of protective clothing, fundamentals of sanitation, survival procedures, use of oxygen at high altitudes, operational fatigue, and air evacuation of the wounded. Lectures were reinforced by practical demonstrations and realistic field exercises.[46]

For doctors assigned to service and combat squadrons or groups, the school offered a tactical surgeons' course. The curriculum included exercises and demonstrations covering a wide range of medical problems connected with tactical operations, and the final phase was given under simulated combat conditions at a field installation of the AAF Tactical Center. During the early part of the war, when the doctors reported to AAFSAT as members of a cadre, the course seemed to be of real significance to the participants. Later, when the course was offered only for those who might be needed as replacements and to officers who correctly anticipated that in most instances they would be returned to previously held assignments in the United States, the interest dropped sharply.[47]

A brief course for senior medical staff officers, in the grade of lieutenant colonel and above, was started in January 1944. The streamlined curriculum presented an up-to-date summary of AAF organizational and tactical trends, as well as the latest doctrines on war neuroses, preventive medicine, survival techniques, and other matters of interest to the flight surgeon. Since the professional training given to doctors at AAFSAT overlapped to a degree the functions of the School of Aviation Medicine at Randolph Field, AAF Headquarters in April 1944 undertook to draw the boundaries more clearly. The School of Aviation Medicine was to emphasize instruction in professional subjects, while AAFSAT was to concentrate on the administrative and tactical duties of medical officers in the field. However, duplication persisted until V-J Day.[48]

AAFSAT had an important part to play in the work of the Army-Navy Staff College (ANSCOL), which was authorized by the Joint Chiefs of Staff in April 1943 for the prosecution of research in the interest of more effective joint operations and for the training of senior officers who might be assigned to joint Army-Navy commands. In-

struction in the several specialties was decentralized among the established service schools, with AAFSAT charged to provide the air phase of the program. Nominations for assignment to this program of study were made, in the rank of major or above, by the commanding officers of the major forces and theater commands, subject to the approval of the War or Navy Department. A small number of staff officers of other allied nations and of State Department foreign service officers were included. It took some time to iron out problems of duplication in offerings by the several associated schools, but ANSCOL, which had its headquarters in Washington, by the fall of 1944 had worked out directives for a clearer delineation of respective responsibilities. At AAFSAT the job was to make certain that the students, who were available for instruction over a period of twenty-four days, acquired a clear understanding of the special potentialities and limitations of the air weapon in joint operations. Although combat experience was a prerequisite for admission to the course, the background of individual members of the successive classes varied greatly. At first, AAFSAT, overestimating the grasp that these officers had of fundamentals, shot too high. Later, it was discovered that instructors had overcorrected—the course had become too elementary. Experience showed that it was necessary to survey the qualifications of each class and to adjust the instruction accordingly.[49]

A separate venture into the field of joint operations had been inaugurated in the fall of 1943 through agreement with the Army Ground Forces. The senior officers' course, suggested by an RAF course for British army officers, was intended to teach ground officers the latest doctrine on the employment of air forces in support of ground operations. This course, having served the purpose of indoctrinating ground officers in the principles underlying FM 100-20,* was adapted in the spring of 1944 to the requirements of air officers. Thereafter, new material on amphibious operations, the employment of carrier-based aircraft, and the latest technical developments, was introduced. The assignment of combat-experienced officers to AAFSAT in 1944 helped to solve the problem of instructors.[50] Additional instruction given at AAFSAT for the benefit of senior ground force personnel included brief indoctrination given during a four-day visit to the center by officers enrolled in the War Department's special

* See above, p. 57.

course for corps and division commanders. These visits, which began in 1943, ended in the spring of the following year.[51]

Junior personnel were not forgotten in the AAFSAT schedule of staff officer training. In June 1943 General Arnold directed that an AAF staff officers' course be established, in order to answer requests from field commanders for qualified young staff officers. The purpose of the program, as outlined by Headquarters, AAF, was to train such personnel for duty in the higher echelons of command. Students were chosen from those ranging in age from twenty-five to thirty-five years, having the rank of captain or major, and preferably with combat experience. The first class of junior officers began in July 1943 at AAFSAT, but the two-week curriculum there was only part of the over-all course, which included trips to staging areas and other field installations as well as study and training duties at Headquarters, AAF. After August 1943 admission to the AAF staff officers' course was limited to graduates of the Command and General Staff School. Before these students reported to AAFSAT, their records were checked, and information was compiled on their civilian and military backgrounds, duty assignments, and combat experience. These data were passed on to the AAFSAT instructors as an aid to them in selecting material for presentation to the class; the information also proved useful in making recommendations for the assignment of these officers in the theaters. The curriculum itself included operational and logistical problems, which were solved by the students individually or in teams. Over 600 junior officers completed the course before it was closed in February 1945.[52]

A more specialized type of instruction was that offered by the Department of Inspection after December 1943. An administrative inspectors' school had been established at Knollwood Field, North Carolina, in June 1942, and was later moved to Fort Logan, Colorado. In January 1943 a technical inspectors' school was started at Chanute Field, Illinois, and was transferred in June of that year to Lowry Field, Colorado. But the two were consolidated as separate divisions of a single department at Orlando in December 1943. By May 1944 the department had developed a general course that undertook to meet the Air Inspector's need for personnel trained in the methods of inspecting installations, equipment, personnel, and training procedures. The curriculum covered the widest range of subjects, including administrative reports and publications, personnel management, various

types of technical equipment, supply procedures, maintenance, and training methods. An advanced air inspectors' course was also taught at AAFSAT, for the purpose of giving review and advanced instruction to selected senior officers. In both courses emphasis was placed upon inspection as a means of constructive improvement, rather than mere criticism and obstruction.[53]

Training at AAFSAT was closely interwoven with the collateral function of research and doctrinal evolution. Responsibility for testing tactics and equipment was shared by the AAF Board, the Proving Ground Command, and the Tactical Center (which included AAFSAT). The AAF Board acted chiefly as a supervisory body; actual testing was performed by the other two agencies. Projects assigned to the Tactical Center by the board included such activities as preparing new field manuals and revising old ones, testing the tactical suitability of new electronic equipment, and making training films to exhibit the most recent combat techniques. The Center had flying personnel, specialists with combat experience, and professional research experts to conduct this work satisfactorily for the board. At the same time these enterprises, by stimulating the thought and interest of the instructional staff of AAFSAT had a beneficial effect upon teaching.

Training of Foreign Nationals

The instruction of foreign nationals became an important part of the AAF's over-all training program during World War II. The so-called Goodwill Act of 24 June 1938, implemented by an executive order of 29 August 1938, had opened schools of the federal government or its agencies to limited numbers of Latin American students.[54] Three years later, the Lend-Lease Act of 11 March 1941 opened a new door for the training of foreign nationals through a provision that not only authorized the supply of U.S. equipment to other nations but also the communication of defense information necessary for the use of such equipment.[55] This statutory basis was subsequently fortified by a ruling of the Attorney General that same year which held that the President as Commander in Chief undoubtedly could use the "forces under his command to instruct others in matters of defense which are vital to the security of the United States."[56]

From May 1941 to the end of 1945 no less than 21,000 airmen from thirty-one foreign nations were graduated from flying and technical

schools in the United States.* Of this number more than half were British, but sizable groups came also from the Latin American countries, China, the Netherlands East Indies, and Free France, while other nations sent smaller contingents for instruction.[57] The agency charged with direct responsibility for conducting most of the foreign programs was the AAF Training Command. It concentrated training for individual countries, so far as possible, within particular subcommands and at certain stations. In this manner the Training Command capitalized on the experience which those organizations developed in dealing with the special problems of a given foreign program.[58]

The first program of instruction for British flyers was initiated at the behest of President Roosevelt. Impressed with the British need for expanded training facilities, and convinced that the defense of Britain was in the interest of American security, the President directed the War Department to consider the possibility of assisting the British to train flyers. On 7 March 1941 General Arnold, through the British air attaché, offered a substantial number of training aircraft for use by the British in training pilots in the United States. At the same time arrangements were made with operators of AAF contract flying schools to establish new facilities for the instruction of British cadets. It was planned to train 3,000 students per year in a twenty-week flying course. Authority over the curriculum and the actual training was left entirely to the RAF, while the AAF Flying Training Command

* This figure includes graduates from schools operated by the British and the Dutch with AAF assistance as well as those graduated from AAF schools. Available statistics do not always agree, but the following table (which includes both pilot and technical training) is approximately right:

Argentina	24	Mexico	447
Australia	55	Netherlands	532
Bolivia	46	New Zealand	1
Brazil	814	Nicaragua	3
Canada	110	Norway	2
Chile	50	Panama	1
China	2,238	Paraguay	2
Colombia	9	Peru	52
Costa Rica	1	Poland	12
Cuba	36	Russia	28
Czechoslovakia	1	Turkey	49
Ecuador	16	Union of South Africa	1
France	4,113	Uruguay	10
Great Britain	12,561	Venezuela	9
Haiti	7	Yugoslavia	68
Honduras	4	TOTAL	21,302

provided for supply, maintenance, and auxiliary services, such as medical care.[59]

A second and larger British pilot program was instituted in June 1941. General Arnold, offering to divert one-third of the training capacity of the AAF to British use, proposed that an additional 4,000 students per year be given instruction in regular AAF schools. Under the earlier 3,000-pilot program, students received the complete pilot course at one school according to the RAF training pattern, but those entering the new program changed schools at the completion of each instructional phase in keeping with the standard AAF practice. Most of the British students were assigned to the Southeast Training Center. A third and smaller program was also begun in mid-1941. Arrangements were completed at that time to enter 150 British students in each regular class of the Air Corps' contract navigation school at Coral Gables, Florida. This quota was intended to supply the RAF with 1,000 navigators annually.[60]

By the middle of 1942 it had become evident that British pilot-training objectives could be reached without continuing the assistance of the United States on the scale previously planned. At the same time, the AAF faced increasing difficulty in providing the facilities necessary for the achievement of its own goals. Accordingly, the 4,000-pilot program and the navigation program were marked for early termination; the last class of pilots was graduated from Air Corps advanced schools in March 1943. The British continued until after V-J Day to send students to the contract schools remaining under their direct control.[61] Only a negligible number of British students received technical training in the United States.*

Although seventeen Latin American countries sent students to the United States for training by the AAF, only Brazil and Mexico had sizable programs. From the passage of the Goodwill Act in 1938 until the end of 1945 the Brazilians constituted about half of all the Latin Americans trained; the Mexicans made up about one-quarter.[62] Instruction for Brazilian pilots began in October 1942, at a time when the AAF training establishment was under heavy pressure. But Brazil's importance as an ally and as one of the two most powerful countries in Latin America argued the need to help in the upbuilding of its air force. Students from Brazil were entered under a series of quotas into

*There were 65 technicians out of the 12,561 graduates.

the Air Corps' pilot-training system; they attended schools, principally in Texas, of the Central Flying Training Command.[63] Most of the graduates returned to their native country for service in the Brazilian Air Force, but one P-47-equipped squadron received full operational training through AAF agencies and was committed to overseas service with the Allied forces in the Mediterranean. This Brazilian 1st Fighter Squadron began its operational training under the jurisdiction of the Sixth Air Force at Aguadulce in Panama, and later was transferred to the First Air Force at Suffolk Army Air Field, New York. The unit left the country in August 1944 for the Mediterranean theater, where it served as an element of XXII Tactical Air Command. The Mexicans also provided a fighter squadron, the 201st, which received operational training from the Second Air Force at Pocatello, Idaho, and sailed for the Southwest Pacific in January 1945.[64] Like the Brazilian squadron, the 201st had been equipped with P-47's. The AAF also gave technical training to personnel of the Latin American air forces. The courses most commonly taken were for aircraft mechanics, armorers, and radio operators; many of the students were eliminees from flying training.[65] An expanded program of Latin American training was continued after the end of the war.

The training of Chinese nationals, which started before Pearl Harbor, continued throughout the war and after. It had been decided in July 1941 that the AAF would undertake pilot and combat crew training for the Chinese Air Force on a small scale, with some additional instruction for mechanics and in armament. Training began in November 1941. During the next two years the AAF resisted proposals for a larger commitment to the program because of its own acute need for training facilities, but as facilities became available after December 1943, the AAF trained an increasing number of Chinese.* These included hundreds of pilots and combat crew members, reconnaissance crews, and ground technicians.[66] The diversified nature of the Chinese training program required the use of numerous AAF installations, most of which were located in Arizona under jurisdiction of the Western Flying Training Command.† All primary flying instruction for Chinese students was given at Thunderbird Field,

* This training program grew out of the plan for the Chinese-American Composite Wing of the Fourteenth Air Force. See Vol. IV, 529 ff.

† Only a few over 300 of the Chinese students were trained as ground technicians. The rest were scheduled for combat crew assignments.

Glendale, Arizona. B-24 pilot transition instruction was given at Kirtland Field, New Mexico, followed by operational training under the Second Air Force at Pueblo, Colorado.

After the Japanese had quickly overrun the Netherlands East Indies (NEI) at the outset of the war, the Netherlands government secured permission for the training of an NEI unit in the United States. The request was for one airfield at which the Netherlanders could conduct their own training. Jackson Army Air Base in Mississippi was assigned for the purpose, and the NEI Air Force detachment reached San Francisco from Melbourne in May 1942. Pilot training, which started soon after their arrival, was the chief focus of the Netherlands program and was conducted almost exclusively at Jackson. Activities at the air base continued under Netherlands control until training was completed there in February 1944. Instruction other than that for pilots was conducted according to regular U.S. procedures: bombardiers, navigators, observers, gunners, and radio operators were taught in AAF schools. During 1943, as newly trained crews and their B-25's began to reach Australia from the United States, the Dutch expanded their operations from northern Australia. The No. 18 NEI Squadron, based in the Darwin area, attacked targets in Java, Timor, and western New Guinea. In July 1944 the No. 120 NEI Squadron, flying P-40 fighters and based at Merauke in Netherlands New Guinea, became the first NEI squadron to operate on Dutch soil since 1942. Both the Mitchell and Kittyhawk squadrons served under RAAF control, and their combat operations guarded the vulnerable Allied left flank in the drive toward the Philippines.[67]

After the successful invasion of North Africa in November 1942 had established contact between the Allies and the French population of that area, Maj. Gen. Carl Spaatz, commanding the Twelfth Air Force, estimated that there were some 1,400 French pilots available for transition training in U.S. aircraft. There were in addition several hundred men available as flying and technical training students. The AAF agreed to accept several groups of French personnel, and the first class of pilot trainees started in June 1943. Some of the graduates received P-40 or B-26 transition, followed by replacement unit training. The French pilot program was concentrated in the southeastern region of the United States, but specialized flying, tactical, and technical instruction was conducted at scattered AAF installations. After the graduation of a number of pilots, combat crew personnel, and

ground technicians that was second only to the total trained for Britain, French training was ended in January 1946.[68] Prior to the summer of 1944, many of these trainees served in the MTO. Following the invasion of southern France in August 1944, all French air combat units in the Mediterranean moved into France, where eventually they became a part of the First Tactical Air Force (Prov.), which supported the 6th Army Group in its drive into Germany.

The AAF trained small numbers of men from countries other than those already mentioned. In some instances only a few nationals of a particular country were involved, and the period of training was generally brief. An example was the two weeks of instruction given to twenty-six Russian officers in September 1941. These officers had been sent to the United States to fly five B-25's to their homeland; prior to making the flight they received transition training at Fort George Wright, Washington. Late in the war two more Soviet officers were trained in the United States—this time technical training on the bombsight. Yugoslavia and Turkey were provided with more comprehensive instructional programs but on a limited scale. Other nations, not previously mentioned, which benefited from AAF training were Australia, New Zealand, Canada, South Africa, Czechoslovakia, Norway, and Poland.[69]

All foreign nationals attending Air Corps schools received approximately the same instruction as that given to U.S. personnel. In some cases, especially in the larger programs, changes in course content were made on request of the foreign military missions; such modifications were made most frequently in the Chinese and French programs. The British pilot-training schools and the NEI school at Jackson Army Air Base were independent of the AAF training system and consequently had different curricula.

Foreign nationals were expected to meet the same standards of proficiency which applied to U.S. students. But several factors encouraged a greater leniency: conditions prevailing in the war-stricken homelands of many of the students forbade rigid standards of selection, some of the students could not measure up physically, many of them suffered in some degree the handicap of a language barrier, and the governments themselves were inclined to encourage policies favoring graduation of the highest possible percentage.[70] The greatest single cause of failure was inadequate preparation in English. Students chosen for training in the United States were supposed to have a working

knowledge of the language, but the requirement was frequently disregarded. The principal remedial device tried was to make instruction in English a major part of the course of study. By April 1944 it was no longer necessary to teach English to Spanish-speaking students, because enough Spanish-speaking instructors were available to conduct training in that language. English remained a part of the curriculum of most other programs, however. More than one-third of the total hours scheduled for preflight instruction of the Chinese students were devoted to English, and language continued to be stressed throughout all phases of Chinese training. The main objective of this effort was to insure that the students became thoroughly familiar with aviation terminology, technical phrases, and expressions essential to their study and work. The problem was attacked from other angles as well. Interpreters were used in most of the foreign programs, and graduates were occasionally withheld to give instruction in their native tongue to later classes, a practice extensively used during the last two years of French training. As much information as possible was presented to the various nationals in their own languages, including translations of standard English texts.[71]

The general relationships between U.S. personnel and representatives of the various foreign nations were friendly, but there were instances of friction which had a deleterious effect upon training. A small minority of the U.S. instructional staff were inclined to regard foreigners as their inferiors, while others lacked a thorough and sympathetic understanding of differences in national background and temperament. A few of them, accustomed to dealing in a bluff manner with U.S. students, offended foreign trainees, who misinterpreted their brusqueness. The foreign nationals showed a reciprocal lack of understanding of their tutors. Some were unduly sensitive and their feelings were aggravated by homesickness in a strange land, whose language they frequently barely comprehended. Special difficulty arose in connection with Latin American training because of its location in an area where prejudice toward Latin Americans was widespread. It was decided in June 1945 to move Mexican training from Foster Field, Victoria, Texas, to Napier Field, Dothan, Alabama.[72]

A high standard of discipline was as essential to the success of foreign as to U.S. training. Enforcing discipline over the troops of another power on American soil, however, required a clear understanding between the United States and the governments concerned.

Agreements were made in the larger programs which permitted the foreign power to maintain discipline among its nationals in accordance with the regulations of its armed forces, while the United States reserved the right to confine foreign trainees until they could be turned over to their own commanders for trial. These arrangements followed the precepts of recognized international law and had the practical advantage to the United States of eliminating the risk of offending foreign pride by court-martial proceedings. Students in Air Corps schools, moreover, were subject to elimination in case of serious disciplinary offenses. Although such elimination was in effect a punishment, the foreign governments seldom protested this exercise of Air Corps authority.[73]

NOTES

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NOTES TO CHAPTER 1

1. The Baker Board listed 14 studies undertaken since World War I, but omitted the Crowell Mission of 1919 (Final Report of the War Department Special Committee on Army Air Corps, 1934, p. 4). For a fuller list see Arthur G. Renstrom, "Principal U.S. Investigations in Aeronautics, 1918–37," *Air Law Review* (Jan. 1938).
2. Baker Board, pp. 11–19.
3. For the GHQ plan, see Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations,* U.S. Army in World War II (Washington, 1950) [hereinafter cited Watson, *Chief of Staff*], pp. 3, 206–7.
4. See Digest of Legislative Proposals, USAF HD, 3787-3.
5. H. H. Arnold, *Global Mission* (New York, 1949), p. 160.
6. AHS-46, Organization of Military Aeronautics, 1935–1945, pp. 2–5.
7. Arnold, *Global Mission,* pp. 176–77.
8. These limitations were in a memo, DC/S (Maj. Gen. S. D. Embick), 9 May 1938, cited in Watson, *Chief of Staff,* p. 36.
9. See *The Army Air Forces in World War II,* I, 53.
10. Memo cited in n. 8.
11. Memo for C/AC from S/W, 29 July 1938, cited in Watson, *Chief of Staff,* p. 36.
12. *Time,* 22 Aug. 1938, p. 24.
13. *Ibid.* Planes, of all types, totaled about 1,600 in this period. See also, rpt., CG AAF to S/W, 4 Jan. 1944, p. 6.
14. Watson, *Chief of Staff,* p. 127.
15. There is a brief sketch of Marshall in Ray S. Cline, *Washington Command Post: The Operations Division,* U.S. Army in World War II (Washington, 1951) [hereinafter cited Cline, *Command Post*], p. 3.
16. Arnold, *Global Mission,* p. 169.
17. Robert E. Sherwood, *Roosevelt and Hopkins* (New York, 1948), p. 100.
18. For example, Ambassador Wilson in a letter of 11 July 1938 (shown to Stimson on 2 Sept.) emphasized the German air threat. See Watson, *Chief of Staff,* p. 132.
19. George Fielding Eliot, *Bombs Bursting in Air* (New York, 1939), p. 81.
20. Arnold, *Global Mission,* pp. 177–80.
21. *Public Papers and Addresses of Franklin D. Roosevelt, 1938* (New York, 1938–50), pp. 547–48.
22. *Ibid.,* p. 564.
23. Watson, *Chief of Staff,* p. 136.
24. *Ibid.,* p. 135, n. 28. No document specifically authorized planning on a half-billion-dollar appropriation, but the figure is cited repeatedly in the October memorandums.
25. *Ibid.,* pp. 132, 134.
26. William Frye, *Marshall, Citizen Soldier* (New York, 1947), pp. 249–51.
27. Arnold, *Global Mission,* p. 177.
28. Watson, *Chief of Staff,* pp. 136–39, based on notes General Arnold took at the conference (see Minutes of the General Council, Vol. I, OPD files).
29. *Ibid.,* pp. 139–43.
30. Arnold, *Global Mission,* p. 175 (Arnold gives no exact date for this meeting, and elsewhere mentions that two sessions were held).
31. *Public Papers and Addresses of Franklin D. Roosevelt, 1939,* pp. 71 ff.
32. *Time,* 23 Jan. 1939, p. 7.
33. Gen. H. H. Arnold, "The President's New Air Program," in Air Corps Stencils, WD Library.
34. Public Law 18, 76 Cong. (H.R. 3791), 3 Apr. 1939. This set a maximum Air Corps plane strength of 6,000.
35. *Time,* 6 Feb. 1939, p. 10.
36. Arnold, *Global Mission,* p. 185.

37. *Ibid.*, p. 186.

38. AHS-46, p. 9, citing memo for G-3 from C/AC, 23 Feb. 1939.

39. AHS-10, Organization of the Army Air Arm, 1935–1945, p. 10.

40. *Public Papers and Addresses of Franklin D. Roosevelt, 1938*, p. 547.

41. Watson, *Chief of Staff*, p. 100.

42. *Ibid.*, p. 101.

43. *Life*, 27 May 1940, pp. 21, 30.

44. Watson, *Chief of Staff*, p. 17.

45. *Ibid.*, p. 166.

46. *San Francisco Chronicle*, 18 Feb. 1947, p. 1.

47. Watson, *Chief of Staff*, p. 47.

48. *Ibid.*, p. 179.

49. See Henry L. Stimson and McGeorge Bundy, *On Active Service in Peace and War* (New York, 1947) [hereinafter cited Stimson, *On Active Service*], pp. 345 ff.

50. Watson, *Chief of Staff*, p. 278.

51. *Ibid.*, p. 279.

52. See *AAF in WW II*, I, 105.

53. Arnold, *Global Mission*, p. 161.

54. *New York Times*, 29 June 1919.

55. For an interesting evidence of how much detail flowed through Hopkins to Arnold, see *Global Mission*, p. 435. Arnold's characterization of Hopkins is on p. 606.

56. Watson, *Chief of Staff*, pp. 304–5 for evidence.

57. Stimson, *On Active Service*, p. 336.

58. *Ibid.*, p. 38.

59. *Ibid.*, p. 333.

60. *Ibid.*, p. 467 and *passim.*

61. Testimony before a Joint Congressional Committee, Aug. 1940. See *AAF in WW II*, I, 116, for the full quotation.

62. Stimson, *On Active Service*, p. 343.

63. *Time*, 10 Aug. 1942. See also *Newsweek*, 21 Apr. 1941, p. 39; Arnold, *Global Mission*, pp. 195, 266.

64. *Time*, 9 Feb. 1942, p. 14.

65. Personal ltr., Marshall to Rep. Ross Collins, 21 June 1940, quoted at some length in Watson, *Chief of Staff*, pp. 25–26.

66. Arnold, *Global Mission*, p. 164.

67. Watson, *Chief of Staff*, p. 77.

68. There is as yet no adequate biography, but Arnold has told his story fully in *Global Mission.*

69. Speech to the National Aviation Forum, May 1940, inserted in *Congressional Record* by Sen. Lundeen of Minnesota. For this and many other such items, see AHS-46, p. 26 and *passim.*

70. AHS-46, p. 27.

71. Watson, *Chief of Staff*, p. 287.

72. Cline, *Command Post*, chaps. I and II give the background on GHQ.

73. Watson, *Chief of Staff*, p. 288.

74. *Ibid.*, citing a memo for Marshall from Arnold, 5 Oct. 1940, with accompanying papers.

75. *Ibid.*, p. 289, quoting a memo from DC/S R. C. Moore and William Bryden to Gen. Marshall, 9 Oct. 1940.

76. *Ibid.*, citing a memo by Brig. Gen. William Shedd, G-1, which accompanied the memo cited in n. 75.

77. AHS-10, pp. 11–12.

78. Memo for C/S from Actg. C/AC, 26 Dec. 1940, cited in AHS-46, pp. 17–18.

79. Ltr., TAG to CG's all armies and others, 19 Nov. 1940 (excerpted as Doc. 9 in app. to 4th AF Hist. Study I-1).

80. For developments in typical AF (Air District), see 4th AF Hist. Study I-1, pp. 52–123.

81. See Watson, *Chief of Staff*, p. 377; *AAF in WW II*, I, 135–39.

82. Watson, *Chief of Staff*, p. 380.

83. Arnold, *Global Mission*, p. 220.

84. Watson, *Chief of Staff*, p. 385.

85. Arnold, *Global Mission*, p. 215.

86. Cline, *Command Post*, pp. 12–13.

87. Ltr., TAG to CG's all armies and others, "Defense Plans," 17 Mar. 1941 (has been reproduced as Doc. 2, app. to 4th AF Hist. Study III-1).

88. Ltr., Lt. Gen. D. C. Emmons, CG GHQ AF to C/S, 23 Dec. 1940.

89. Memo for AC/S, G-3 from Brig. Gen. L. T. Gerow, Actg. AC/S WPD, 10 Feb. 1941.

90. Rpt. of Committee of Officers assembled to discuss AWS, 18 Feb. 1941.

91. Memo for C/S from Gen. Arnold (drafted by Maj. Gordon Saville), 20 Feb. 1941.

92. Memo for Gen. Spaatz (Plans Div., OCAC) from Maj. K. N. Walker, 21 Feb. 1941.

93. Watson, *Chief of Staff*, p. 51.

94. Memo for AC/S WPD from Maj. Gen. William Bryden, DC/S, 28 Feb. 1941.

95. A full discussion of these orders is in 4th AF Hist. Study III-1, and excerpts are reproduced in its appendix.

96. Gen. Marshall prepared a draft from which Patterson sent letters to Senators David Walsh and Robert Reynolds, 20 Feb. 1941. See AHS-46, p. 31.

97. Watson, *Chief of Staff*, p. 290, citing memo for S/W from AS/W, 10 Mar. 1941.

98. *Ibid.*, p. 291.

99. Ltr., Stimson to chairmen of House and Senate Military Affairs Committees, 20 June 1941, describing the order given in March. See AHS-10, p. 13.

100. Watson, *Chief of Staff*, p. 291.

101. *Newsweek*, 21 Apr. 1941, p. 39.

102. Watson, *Chief of Staff*, p. 292, citing notes on conference in Off. C/S, 3 Apr. 1941.

103. AHS-46, p. 34, citing *Congressional Record*, 77 Cong., 1 Sess., 3406–7.

104. *Ibid.*, p. 20, citing memo for C/S from OCAC, 13 May 1941, and other papers.

105. *Ibid.*, p. 21, citing memo for C/S from Brig. Gen. H. L. Twaddle, 14 June 1941.

106. *Ibid.*, pp. 21–22.

107. *Ibid.*, pp. 22–25, and R. Earl McClendon, The Question of Autonomy for the United States Air Arm, 1907–1945, AU Doc. Research Study, p. 191. AR 95-5 is reproduced by McClendon, pp. 277–80.

108. Cline, *Command Post*, p. 13, citing memo of 30 June 1941.

109. Arnold, *Global Mission*, p. 209.

110. *Ibid.*, p. 248.

111. Ltr., S/W to Sen. Reynolds, 19 Sept. 1941, approved by C/S, quoted at length in Watson, *Chief of Staff*, pp. 294–95.

112. Cline, *Command Post*, p. 62.

113. *Ibid.*, p. 67.

114. *Ibid.*, p. 70.

115. AHS-10, p. 15.

116. Cline, *Command Post*, p. 73, citing notes of conference in Marshall's office.

117. *Ibid.*, p. 72.

118. *Ibid.*, pp. 72–73.

NOTES TO CHAPTER 2

1. R. Earl McClendon, The Question of Autonomy for the United States Air Arm, 1907–1945, AU Doc. Research Study, p. 223.

2. Ray S. Cline, *Washington Command Post* (Washington, 1951), pp. 90–91.

3. AHS-10, Organization of the Army Air Arm, 1935–1945, pp. 17–18.

4. Cline, *Washington Command Post*, pp. 91–92.

5. *Time*, 9 Feb. 1942, p. 15.

6. Henry L. Stimson and McGeorge Bundy, *On Active Service in Peace and War* (New York, 1947), p. 449.

7. WD Circular 59 is reproduced in McClendon, Autonomy for Air, p. 283 ff.

8. Dwight D. Eisenhower, *Crusade in Europe* (New York, 1948), p. 50.

9. WD Circular 59, 2 Mar. 1942, par. 6, b; cf. AR 95-5.

10. All figures in this paragraph, except as otherwise noted, are from the AAF Statistical Digest, World War II, prepared by the Office of Statistical Control, Dec. 1945.

11. AAF Stat. Digest, p. 297.

12. AHS-10, pp. 47–52.

13. *Ibid.*, p. 46

14. A detailed contemporary statement is "AAF, Statement of Functions," revised to 6 March 1942, A.C. W-6869.

15. AHS-10, p. 51.

16. *Ibid.*, pp. 49, 70.

17. *Ibid.*, pp. 41–44 and chap. VI.

18. For discussions of methods of reporting and compilation, see AAF Stat. Digest, especially pp. iii, 13–14, 111, 219.

19. See especially Col. Guido R. Perera, Hist. Org. and Opns. of the COA, and Rpt. of COA, 8 Mar. 1943.

20. L. R. Thiesmeyer and J. E. Burchard, *Combat Scientists* (Boston, 1947), p. 25.

21. Eighth Air Force Tactical Development, a study prepared at the close of the war, reviews the fascinating story of tactical experimentation in the continuing effort to get the bombers through to their targets.

22. Thiesmeyer and Burchard, *Combat Scientists*, pp. 184–85.

23. AHS-10, p. 88; *Combat Scientists*, p. 25.

24. Henry H. Arnold, "Science and

Air Power," *Air Affairs* (Dec. 1946), p. 185.

25. AHS-10, p. 72.

26. *Ibid.*, pp. 70–77.

27. *Ibid.*, p. 79, quoting memo for Maj. Gen. O. P. Echols *et al.* from C/AS, 25 Mar. 1943.

28. AHS-10, p. 80. This study has been a general source for the foregoing discussion of organization, together with the *AAF: The Official Guide to the Army Air Forces* (N.Y., 1944), a wartime publication, and the customary charts and tables of organization.

29. AHS-10, p. 118.

30. *Ibid.*, pp. 91–98.

31. H. H. Arnold, *Global Mission* (New York, 1949), p. 274.

32. See Cline, *Command Post*, pp. 98–101.

33. McClendon, Autonomy for Air, p. 229.

34. William Leahy, *I Was There* (New York, 1950), p. 106.

35. Robert E. Sherwood, *Roosevelt and Hopkins* (New York, 1948), p. 472.

36. Cline, *Command Post*, pp. 98–99. See also *AAF in WW II*, I, 255–57.

37. For discussion of WD, particularly OPD, attitudes, see Cline, *Command Post*, pp. 249–57.

38. Comment by General Kuter at postwar conference on defense organization attended by editor.

39. Cline, *Command Post*, 117 n.

40. *Ibid.*, pp. 108, 115, 192.

41. *Ibid.*, p. 103.

42. *Ibid.*, pp. 235–36.

43. *Ibid.*, pp. 234 ff.

44. *Ibid.*, p. 239 n.

45. *Ibid.*, pp. 240–41, 250.

46. *Ibid.*, pp. 254–55.

47. *Ibid.*, p. 251.

48. *Ibid.*

49. *Ibid.*, p. 252.

50. AR 95-10 describes the units of an air force. Cf. The Air Force in Theaters of Operations, Booklet 1 (1943), and *AAF: The Official Guide*, pp. 17–22.

51. Late in the war squadron strengths were augmented. Compare figures in *AAF: The Official Guide*, p. 21, with those in AAF Stat. Digest, p. 1.

52. See Air Univ., Course 320, Air Organization (July 1951), Pt. I, pp. 23–25.

53. See especially John M. Coleman, *The Development of Tactical Services in the Army Air Forces* (New York, 1950).

54. See AHS-10, chap. IV, especially p. 62.

55. *Ibid.*, p. 63.

56. Hist. CFTC, 1939–41, pp. 27–31.

57. This figure, and much data for this section, comes from a draft (never published) Biennial Report of the AAF, 1 July 1941 to 30 June 1943 [hereinafter cited as Biennial Report], chart 17.

58. For background see Arnold, *Global Mission*, p. 292.

59. AHS-10, pp. 55–59; Hist. AAF Mat. Comd., 1926–41.

60. AHS-10, p. 115.

61. *Ibid.*, p. 65.

62. See Hist. AAF Proving Ground Comd., especially Pt. I; for a popular account, see *AAF: The Official Guide*, p. 176.

63. AHS-13, The Development of Tactical Doctrines at AAFSAT and AAFTAC, pp. 6–8.

64. On 26 March 1942 the Air Defense Operational Training Unit was created; on 30 March it became the Interceptor Command School, and on 28 May was renamed Fighter Command School (Hist. Ftr. Comd. Sch., AAFTAC, p. 24 ff.).

65. AHS-13, p. 22 ff.

66. AHS-10, pp. 110–12.

67. CG AAF, Second Rpt., 27 Feb. 1945, p. 84; Hist. AACS, III, 947–51.

68. Biennial Report, p. 4 and chart 6.

69. AHS-10, pp. 66, 78–80.

70. AR 95-150, 15 May 1945. (There were minor exceptions.)

71. AAF Reg. 20–58, 1 July 1945.

72. AHS-10, pp. 65–66.

73. *Ibid.*, p. 157, n. 11; *AAF: The Official Guide*, pp. 90, 334.

74. Hq. GHQ AF GO 11, 26 Mar. 1941, based on authority of ltr., TAG to CG's all armies *et al.*, 17 Mar. 1941.

75. Ltr., Hq. GHQ AF to CG each air force, 12 Apr. 1941, quoted in 4th AF Hist. Study I-1, p. 74.

76. For a full discussion, see 4th AF Study I-1, pp. 95–97 (quoting ltr., TAG to C/AAF, 25 July 1941).

77. The commands were projected in July 1941 as "Air Force Service Commands" (*ibid.*, p. 106), but were activated

pursuant to AFCC GO 48, 8 Oct. 1941. Redesignation to Air Force Base Commands was ordered by Hq., AFCC on 22 Oct. 1941 (*ibid.*, p. 110) to avoid confusion with the new Air Service Command.

78. This was directed on 12 April 1941 (see n. 75 above).

79. WD ltr. AG 320.2, 7 May 1942, gave authority to disband, and action followed promptly.

80. 3d AF GO 100, 10 Apr. 1944.

81. Hist. 2d AF, Dec. 1941–Dec. 1942, II, 363–73.

82. See Hist. I Ftr. Comd., Dec. 1941–July 1944, I, 3.

83. Hist. 1st AF, 1940–Dec. 1943, I, 10–11.

84. 4th AF Study I-2, Vol. I, 181–98; Hist. I Ftr. Comd., Dec. 1941–July 1944, I, 3–4.

85. AAF Stat. Digest, p. 23 for personnel and p. 144 for combat aircraft figures.

86. Ltr., TAG to CG AAF, 10 Sept. 1943 (see 4th AF Study III-2, Vol. I, 49).

87. AAF Stat. Digest, p. 6.

88. 4th AF Study I-2, Vol. I, 287–300; Vol. II, p. 432.

89. Ltr., TAG to CG AAF *et al.*, 23 Feb. 1944.

90. AU, Course 320, Air Orgn., Pt. I, p. 25.

91. 4th AF Study I-2, Vol. II, 298, 322–57, 427–35.

92. Organizational Developments, First Air Force, 1944, pp. 15–37.

93. AHS-10, pp. 108–10.

94. Rpt. of C/S USAF to SAF, 30 June 1948, p. 19.

NOTES TO CHAPTER 3

1. N.Y. *Daily News*, 14 Oct. 1941. See also Oswald Garrison Villard, *Our Military Chaos* (N.Y., 1939), pp. 68–69.

2. Los Angeles *Examiner*, 22 Oct. 1941. The commander of the air force units asked for counter-publicity by an equally prominent Navy official (ltr., Maj. Gen. J. E. Fickel, CG 4th AF to CG AFCC, 22 Oct. 1941).

3. For text, see *Peace and War: U.S. Foreign Policy, 1931–1941* (Washington, D.C., 1943).

4. See, for example, Walter Lippmann in *Los Angeles Times*, 3 Feb. 1942.

5. Editorial, *New York Times*, 18 Apr. 1920.

6. William Mitchell, *Winged Defense* (N.Y., 1925), p. 199.

7. *Ibid.*, p. 211.

8. *Ibid.*, p. 205.

9. Memo for AC/S WPD from Maj. Gen. B. D. Foulois, 14 Nov. 1932; lecture by Foulois at Army War College, 12 Sept. 1933.

10. See 4th AF Hist. Study I-1, Vol. II, doc. 4, for the notes prepared by Gen. Arnold.

11. Ltr., TAG to CG 1st Army, 21 May 1935, in Hist. Air Defense Comd., app. 1.

12. Rpt. of AC Bd., Study No. 21, Modernization of the Army, 9 Jan. 1936, annex III.

13. Hist. Air Defense Comd., apps. 4 and 5, The AWS in the 1937 Maneuver, and Summary of a Sector Exercise, Apr. 1938.

14. Summary of the Joint AA-AC Exercise, Sept. 1938, in Hist. Air Defense Comd., app. 6.

15. Ltr., TAG to CG GHQ AF, 15 Apr. 1936. The AWS for continental U.S. "can be established in a few days and can be operated largely by civilians."

16. See Mr. Johnson's remarks in Annual Report of the Secretary of War, 1938, pp. 26–27, quoted in Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations*, p. 129.

17. Watson, *Chief of Staff*, p. 150.

18. *Ibid.*, p. 151.

19. J. P. Baxter, *Scientists Against Time* (Boston, 1946), p. 139.

20. Joint Bd. on Scientific Info. Policy, Radar, A Report on Science at War (1945), p. 7.

21. Signal Corps Development of Aircraft Warning Service, p. 1.

22. Brig. Gen. H. H. McClelland at Maxwell Fld. conf., 20 Feb. 1944, cited in Air Historical Study (draft), Development of Radio and Radar Equipment for Air Operations, 1939–1944.

23. Baxter, *Scientists Against Time*, p. 142, quoting Sir Robert Watson-Watt.

24. For British radar developments, see

Radar, a report by the British Information Service (1946), p. 5 and *passim.*

25. Baxter, *Scientists Against Time*, p. 142.

26. *Ibid.*, pp. 146–47.

27. Air Historical Study (draft), Development of Radio and Radar Equipment for Air Operations, 1939–1944, pp. 24–25.

28. Memo for C/S from Arnold, C/AC, 24 Nov. 1939.

29. Hist. Air Defense Comd., app. 8.

30. *Ibid.*, pp. 220–24 and app. 11 (Final Report by Chaney).

31. *Ibid.*, app. 30 (Chaney's "Observations on Trip to England").

32. Maj. K. N. Walker, Report . . . of Air Defense Exercise in New England, 27 Jan. 1941; Hist. Air Defense Comd., pp. 264–97.

33. Hist. Air Defense Comd., pp. 195–213.

34. *Ibid.*, app. 2 (TAG ltr., AWS, Continental U.S., 23 May 1940).

35. Hist. Air Defense Comd., app. 26 (TAG ltr., 7 Mar. 1941 and ltr., GHQ AF, 12 Apr. 1941); TAG ltr., 25 Mar. 1941.

36. Exec. Order 8757, 20 May 1941.

37. Hist. III Ftr. Comd., 1941, pp. 7–10.

38. Hist. I Ftr. Comd., 1941–44, p. 27.

39. 4th AF Study III–1, Vol. I, 233.

40. AAF Stat. Digest, p. 140.

41. 4th AF Study III-1, Vol. I, 53–61, 251.

42. OCD instructional ltr., 11 Aug. 1941.

43. *Ibid.*, specifies a post to every 32 square miles, but cf. 4th AF Study III-1, Vol. I, 113.

44. Hist. III Intcp. Comd., 1941, exhibit 16.

45. Ltr., GHQ AF, "Site Board Reports," 20 June 1941, digested in 4th AF Study I-1, Vol. I, 237–38.

46. Hist. I Intcp. Comd., 1941, I, 84–96; 4th AF Study III-1, Vol. I, 102–12.

47. Tentative Manual . . . for Air Defense, 8 Aug. 1941, in 4th AF Study III-1, Vol. II, doc. 29.

48. 47 *Stat.* 412 (Sec. 322 of Act of 30 June 1932).

49. Hist. I Intcp. Comd., 1941, I, 62–65, II, app. 9; 56 *Stat.* 247, 28 Apr. 1942.

50. Compiled from histories of the four continental interceptor commands.

51. Hist. I Intcp. Comd., 1941, I, 189–227.

52. Hist. III Intcp. Comd., 1941, pp. 26–29.

53. Hist. Seattle Ftr. Wg., I, 4–5; 4th AF Study III-1, Vol. I, 154–65.

54. Watson, *Chief of Staff*, p. 240.

55. Proceedings of a board of officers convened at Washington, D.C., on 28 Oct. 1941 to develop the AWS program for the Second Aviation Objective.

56. 4th AF Study III-2, Vol. I, 2; see also Joint Action of the Army and Navy, 1935 (revised), par. 30b, c.

57. Memo for Arnold from AWPD (Col. George), 2 Feb. 1942.

58. Memo for C/S from AWPD, n.d. (*ca.* 10 Dec. 1941).

59. Telephone conversation, Marshall and DeWitt, 12 Dec. 1941.

60. See memo for CG AAF from WPD, 1 Aug. 1942.

61. Ltr., TAG to CG WDC and others, 30 Dec. 1941, quoted in 4th AF Study I-1, Vol. I, 292.

62. Ltr., GHQ to DC/S for Air, 15 Jan. 1942, annex 2, tab E, as reproduced in Hist. I Air Support Comd.

63. Hq. EDC GO 34, 20 Nov. 1942.

64. Unnumbered WD Cir., National Policy of Air Defense, 11 Mar. 1942.

65. See 4th AF Study I-2, Vol. I, 154–57.

66. Ltr., TAG to CG's 1st and 4th AF's, 6 Aug. 1942, in Hist. Norfolk Ftr. Wg. to 31 Dec. 1942, app. 1.

67. Hist. I Ftr. Comd., I, 16–25.

68. 4th AF Study I-2, Vol. I, 147, and Vol. V, doc. 152.

69. See Chart I for chap. 2 of Booklet II (Fighter Command and Air Defense) of the manual, The Air Force in Theaters of Operations, Hq. AAF, May 1943.

70. AAF Reg. 20-1, Organization of the AAF, 16 June 1942; Hist. Ftr. Comd. Sch., AAFTAC, Mar.–Nov. 1942, p. 24 ff.; AAFSAT Training and Testing, 5 Nov. 1942–29 Oct. 1943, Air Defense, I, 4–9; AHS-13, Development of Tactical Doctrines at AAFSAT and AAFTAC, pp. 9–11.

71. See Maj. Gordon P. Saville, Manual on Air Defense Doctrine, 27 Oct. 1941.

72. See reference to report of Eubank to Arnold in October 1943, in AHS-13, pp. 87–88.

73. For the west coast radars see 4th AF Study III-2, Vol. I, 146 ff.; for the east coast, see Hist. I Ftr. Comd., I, 109–11.

74. "Orientation Concerning Controlled Interception," a lecture for the Ftr. Comd. Sch., in app. V, documents of the Ftr. Comd. Sch., 28 Mar.–5 Nov. 1942.

75. For a contemporary estimate see the memo for C/S from Col. T. J. Hanley, AC/AS A-4, Unsuitability of SCR-270, 7 Feb. 1942.

76. See the summary of the Watson-Watt report and the AAF concurring views in memo for Gen. Arnold from Lt. Col. Gordon Saville, D/Air Defense, 30 Jan. 1942.

77. Hist. Signal Corps Research and Development, IV, Pt. 3, 2–3.

78. Memo for Col. G. P. Saville, D/Air Defense from Col. R. C. Maude, 11 June 1942.

79. Hist. Signal Corps Research and Development, IV, Pt. 3, 1–5.

80. Hist. Ftr. Comd. Sch. (1942), p. 11; see also lecture on British radar equipment, in documents of the Ftr. Comd. Sch., app. 5.

81. "Longhairs and Short Waves," *Fortune* (Nov. 1945), pp. 162–69.

82. 4th AF Study III-2, Vol. I, 147.

83. *Ibid.*, chap. 3, esp. pp. 159 and 179–89.

84. Hist. I Ftr. Comd., I, 110–19, 134–52.

85. Source cited in n. 74 concluded: "the directives for siting, operation, and performance of radar have been gravely inadequate and technically erroneous."

86. Ltr., Lt. Col. A. L. Pachynski, IV Intcp. Comd. to O/CSigO, 27 Apr. 1942.

87. Ltr., Hq. AAF to CG 1st AF and others, 5 Apr. 1944.

88. Hist. I Ftr. Comd., I, 128–30; 4th AF Study III-2, Vol. I, 191.

89. Hist. I Ftr. Comd., I, 67; 4th AF Study III-2, Vol. I, 74; Defense Activities of the 3d AF, pp. 79–83.

90. Brig. Gen. G. P. Saville, "Our Air Defense Network," *Air Force* (Apr. 1943).

91. Hist. I Ftr. Comd., I, 68–69, citing TAG ltr., 15 July 1942.

92. See n. 88 above.

93. FM 11-25, AWS, 3 Aug. 1942, p. 97.

94. 4th AF Study III-2, Vol. I, 76, quoting the *Oakland Tribune*, 1 Sept. 1942.

95. Hist. Boston Ftr. Wg., 1941–44, p. 42; Hist. I Ftr. Comd., I, 171–72; 4th AF Study III-2, Vol. II, app. 52.

96. Ltr., GHQ to WTO, 28 Jan. 1942, and ind. thereto.

97. Ltr., S/W to Sen. Homer T. Bone, 13 Jan. 1943.

98. Hist. I Ftr. Comd., I, 186–87; 4th AF Study III-2, Vol. I, 92–101.

99. Hist. I Ftr. Comd., I, 108.

100. 4th AF Study III-2, Vol. I, 96–97, 103; Hist. I Ftr. Comd., I, 183–85.

101. Watson-Watt was very critical and doubted that timely reporting could be expected from volunteers (4th AF Study III-1, app., doc. 40).

102. Hist. I Ftr. Comd., I, 179–82.

103. Hist. Philadelphia Ftr. Wg., to Dec. 1942, p. 48; Hist. New York Ftr. Wg., 1941–44, pp. 22–23.

104. Hist. I Ftr. Comd., I, 176–78.

105. *Ibid.*, I, 215.

106. Standard procedure as taught at the Fighter Command School in 1942 is described in "The Radar Filter Room," part of the lecture materials included in documents of the Fighter Command School, app. 5. See also FM 11-25, Aircraft Warning Service, 3 Aug. 1942. For exact procedures in a typical defense area, see "Standard Operating Procedure for Information and Filter Centers," 25 Sept. 1943, in Hist. I Ftr. Comd., III, app. E-16.

107. Brig. Gen. G. P. Saville, "Our Air Defense Network," *Air Force* (Apr. 1943).

108. See n. 104.

109. Hist. I Ftr. Comd., I, 199–202; Hist. New York Ftr. Wg., 1941–44, p. 97.

110. See FM 11-25, 3 Aug. 1942, p. 9 ff.

111. For typical security measures, see Hist. New York Ftr. Wg., 1941–44, p. 28.

112. History of the WAC Detachment, New York Ftr. Wg., to Dec. 1943; see also histories of Philadelphia Ftr. Wg., and of the Charleston Air Region.

113. See p. 8 of first source in previous note; Hist. I Ftr. Comd., I, 205–6.

114. See app. 44 of documents to Hist. Albany Air Region, 1941–44.

115. See Hist. I Ftr. Comd., III, app.

E-14, a letter which included "Regulations of AAF Aircraft Warning Corps."

116. A typical account is in Hist. New York Ftr. Wg., 1941–44, p. 46.

117. See the histories of the fighter wings, especially Hist. Seattle Ftr. Wg., Aug. 1942–Dec. 1943, I, 2.

118. Hist. I Ftr. Comd., I, table facing p. 72.

119. 4th AF Study III-2, Vol. I, 72–73.

120. Ltr., Hq. AFCC to C/AAF, 5 Jan. 1942; Defense Activities of the Third Air Force, 1941–44, pp. 78–79.

121. Ltr., TAG to CG EDC and others, 7 June 1942.

122. 3d ind. (ltr. cited in n. 119), IV Ftr. Comd. to CG 4th AF, 8 Aug. 1942.

123. Hist. Philadelphia Ftr. Wg., Dec. 1941–Dec. 1942, I, 46.

124. Source cited in n. 120.

125. Hist. I Ftr. Comd., I, 221.

126. There is a large literature on this point. See Hist. I Ftr. Comd., I, 223, and the following: [EDC] "SOP–Fighter-AAA Team," 20 Nov. 1942; memo for Col. G. P. Saville from Col. R. C. Maude, AW Div., 11 June 1942; 4th AF Study III-2, Vol. II, doc. 82.

127. Perhaps the best account of relations with the Navy is chap. 9 of 4th AF Study III-2, Vol. II, 465–500.

128. *Ibid.*, I, 137; Hist. I Ftr. Comd., I, 154.

129. Hist. Boston Ftr. Wg., 1941–44, pp. 21–23.

130. OCD Pamphlet 11, Air Raid Warning System (11 Sept. 1941) was the basic document, but see also Hist. I Ftr. Comd., I, 258, and 4th AF Study III-2, Vol. II, doc. 66.

131. The Air Force in Theaters of Operation (Hqs. AAF, May 1943), chap. 2, p. 2; FM 1-15, Tactics and Technique of Air Fighting, 10 Apr. 1942.

132. FM 1-15, 10 Apr. 1942.

133. FM 1-25, Air Defense, 15 June 1943, p. 5.

134. For details see FM 11-25, 3 Aug. 1942, pp. 75–79.

135. See "Orientation Concerning Controlled Interception," part of the course materials reproduced as app. V, documents of Ftr. Comd. Sch., 28 Mar.–5 Nov. 1942.

136. Hist. 33d Ftr. Control Sq., 1941–44, p. 2.

137. 4th AF Study III-2, Vol. I, 235; Hist. I Ftr. Comd., I, 277.

138. "VHF Control Systems Project," in 4th AF Study III-2, Vol. IV, doc. 113; Hist. I Ftr. Comd., I, 278.

139. 4th AF Study III-2, Vol. I, 236; Hist. I Ftr. Comd., I, 280.

140. 4th AF Study III-2, Vol. I, 240–50; Hist. I Ftr. Comd., I, 282.

141. Hist. 91st Ftr. Control Sq., Mar. 1943–Apr. 1944, pp. 7–21.

142. See Hist. 92d Ftr. Control Sq., Apr.–Dec. 1943, app. 3.

143. Ltr., TAG to CG ETO and others, 15 Jan. 1942.

144. For typical problems, see Hist. 91st Ftr. Control Sq., Mar. 1943–Apr. 1944, pp. 4–5, 22–23.

145. Tab D, incl. with memo for Col. R. H. Wooten, GHQ from Hq., I Intcp. Comd., 14 Jan. 1942.

146. 4th AF Study III-1, Vol. II, doc. 86.

147. Hist. New York Ftr. Wg., 1941–44, app., pp. 36–38.

148. Hist. Philadelphia Ftr. Wg., Jan. 1943–July 1944, II, app. 155.

149. See p. 5 of the pamphlet "AA in a Fighter Command," part of the lecture material in app. V, documents of Ftr. Comd. Sch., 28 Mar.–5 Nov. 1942.

150. 1st Army GO 33, 10 Dec. 1941; Hist. 1st AF, 1940–43, I, app. 21.

151. Hist. 4th AA Comd., I, 90–93.

152. WD Training Cir. 71, 18 Dec. 1941.

153. Hist. Eastern Defense Comd., pp. 58–60; Hist. 4th AA Comd., I, 34.

154. FM 4-100, AAA Organization and Tactics; The Air Force in Theaters of Operation (May 1943), chap. 2, p. 4.

155. Hist. I Ftr. Comd., II, app. A-18, citing ltr., EDC to CG's AAA and others, sub.: "Operational Control of AAA," 11 Apr. 1942.

156. Hist. Norfolk Ftr. Wg. to Dec. 1942, app. 12.

157. Memo for Arnold from Col. G. P. Saville, 29 May 1942.

158. Ltr., EDC to CG 1st AF and others, 25 Sept. 1942.

159. Ltr., Arnold to Maj. Gen. J. E. Chaney, 7 Oct. 1942.

160. There is a full account in the excellent study, Hist. 4th AA Comd., I, 45 ff. (for the assignment order see Vol. II, doc. 18).

161. *Ibid.*, quoting memo for C/S from CG AGF, 25 Mar. 1944.

162. *Ibid.*, I, 49, quoting ltr., CG 4th AA Comd. to CG 4th AF, 24 Nov. 1944.

163. FM 100-20, Command and Employment of Air Power, 21 July 1943, sec. IV, par. 18b.

164. [EDC], "SOP, Fighter-AAA Team," 20 Nov. 1942.

165. Hist. Eastern Defense Comd., p. 58.

166. 4th AF Study III-2, Vol. IV, doc. 142, and I, 303.

167. Hist. 4th AA Comd., I, 28.

168. For the estimates of a British mission which visited the Pacific coast, 31 Aug. to 17 Oct. 1942, see Hist. 4th AA Comd., V, app. C-3.

169. *Ibid.*, I, 105–9.

170. Memo for C/S from G-2, sub.: Inadequacy of Measures . . . for Sault Ste Marie, 11 Feb. 1942.

171. Rpt. of Bd. of Officers, 25 Feb. 1942.

172. R&R, AFRAD to AFACT, 6 Aug. 1942.

173. R&R, AFRAD to AWPD, 8 Mar. 1942.

174. Incl. 2, memo for AC/S Opns. Div. from OC&R, Estimate of Requirements, 3 May 1943.

175. Unnumbered WD Cir., Central Air Defense Zone, 29 Sept. 1942.

176. FM 1-25, Air Defense, 15 June 1943, p. 15; lecture, Barrage Balloons in a Fighter Command, 15 Oct. 1942, in app. 5, documents of the Ftr. Comd. Sch.

177. AHS-3, Barrage Balloon Development in the United States Army Air Corps, 1923–1942, p. 45.

178. *Ibid.*, pp. 1–22.

179. *Ibid.*, chaps. 2 and 3.

180. *Ibid.*, p. 38.

181. Hist. 4th AA Comd., I, 137–43.

182. IV Ftr. Comd. Memo 55-9, 23 Nov. 1942 (revised 9 Apr. 1943), in Hist. 4th AA Comd., I, 153.

183. *Ibid.*, I, 144.

184. *Ibid.*, I, 149.

185. *Ibid.*, I, 146.

186. *Ibid.*, I, 135–37.

187. *Ibid.*, I, 155, citing memo from Col. Rosenblatt to AS/WA, 18 Nov. 1942.

188. *Ibid.*, I, 154 and II, doc. 19 of app. C.

189. *Ibid.*, I, 150–62.

190. 4th AF Study III-2, Vol. II, 323.

191. *Ibid.*, chap. VII.

192. Hist. Western Defense Comd., IV, app. 5 (G-2 Chronology of Enemy Operations on Pacific Coast).

193. For a case in the first week of the war, see 4th AF Study I-1, Vol. I, 277.

194. R&R, comment 1, Stratemeyer, C/AS, 19 Feb. 1943, accompanying memo for C/S.

195. 4th AF Study III-2, Vol. I, 3, citing WDC ltr. of 20 Apr. 1943.

196. Memo for Arnold from Brig. Gen. L. S. Kuter, 2 July 1943.

197. 4th AF Study III-2, Vol. I, 49, citing ltr., TAG to CG AAF, 10 Sept. 1943.

198. Hist. Boston Ftr. Wg., 1941–44, app. 20 (memo for CG EDC and others from TAG, 20 Sept. 1943).

199. Hist. I Ftr. Comd., I, 190–91, 231–32; 4th AF Study III-2, Vol. I, 142.

200. 4th AF Study III-2, Vol. I, 5, citing radg., WD to CG WDC, 30 Oct. 1943.

201. *Ibid.*, II, doc. 15; Hist. I Ftr. Comd., I, 163.

202. See 4th AF Study III-2, Vol. I, 53 for the effects.

203. *Ibid.*, II, doc. 22 (AAF teletype, 17 Apr. 1944).

204. Ltr., S/W to all volunteers AWS, 16 May 1944, quoted in Hist. Boston Ftr. Wg., May–July 1944, app. 48.

205. Organizational Developments, 1st AF, 1944, app. 13; 4th AF Study I-2, Vol. VII, doc. 152; 4th AF Study III-2, Vol. I, 188.

206. Hist. I Ftr. Comd., I, 164, 282–85.

207. 4th AF Study III-2, Vol. I, 240–50 (and for radar, pp. 218–19).

208. *Ibid.*, pp. 66–70.

209. Hist. Eastern Defense Comd., pp. 61–62; Hist. 43d AAA Brig. July–Dec. 1944, pp. 8–9.

210. 4th AF Study III-2, Vol. II, doc. 223, quoting *San Francisco Examiner*, 2 Oct. 1945 (interview with Japanese officials).

211. Special USSBS interview with Capt. Endo, Japanese Ordnance Bureau, (draft, no date). See Masuo Kato, *The Lost War* (New York, 1946), pp. 138–39; see also, USSBS Japanese Army, Ordnance, p. 15.

212. 4th AF Study III-2, Vol. II, 504–8. A popular account is in Brig. Gen. W.

H. Wilbur, former Chief of Staff, WDC, "Those Japanese Balloons," *Reader's Digest* (Aug. 1950).

213. 4th AF Study III-2, Vol. II, 501–3.

214. *Ibid.*, p. 510.

215. *Ibid.*, p. 504.

216. *Ibid.*, pp. 512–15.

217. *Time*, 30 May 1949, p. 17.

218. This is the conclusion of Gen. Wilbur's article in *Reader's Digest*, Aug. 1950, p. 24.

NOTES TO CHAPTER 4

1. WD, Immediate Release, 18 Jan. 1939, statement before House Military Affairs Committee.

2. Memo for C/AS from Lt. Col. H. L. George, AC/AS AWPD, 14 Oct. 1941.

3. OCAC Station List, 2 Mar. 1939; Daily Diary, Air Installations Div. (AID), AC/AS Materiel and Services (M&S), 26 Sept. 1945, pp. 2–3.

4. AID, AC/AS-4, Summary of Real Estate and Construction Costs for AAF Installations, 15 Sept. 1946, *passim;* WD, Office of Chief of Engineers (OCE), Quarterly Inventory: Owned, Sponsored and Leased Facilities, 30 Sept. 1945, pp. 23, 103, 187. Command facilities were those installations developed or procured to complete the AAF operational mission; they do not include other industrial facilities constructed under the sponsorship of the AAF for aircraft production or modification.

5. Information presented in regard to each individual station in this chapter, unless otherwise cited, is from the station history. Citations to these station histories may be found in AHS-69, Development of AAF Base Facilities in the United States, 1939–1945.

6. Exec. Order No. 7215, 26 Oct. 1935; memo for C/WPD from Brig. Gen. O. Westover, AC/AC, 28 May 1934; R&R, Col. R. B. Lincoln, C/Plans Sec., OCAC to C/Inspections Sec., OCAC, 22 Oct. 1937; ltr., Comdr. V. C. Griffin to CO Bolling Fld., 15 Nov. 1937.

7. Public Law 263, 74 Cong., 1 Sess., 49 *Stat.* 594, 12 Aug. 1935.

8. Air Corps Bd., Study No. 5: Report on Overhead Bomb-Proof Protection for Air Bases, 8 Jan. 1936.

9. R&R, Col. R. B. Lincoln, C/Plans Sec., OCAC to C/Supply Div., OCAC, 11 Nov. 1937.

10. Hist. AAFFTC and Its Predecessors, 1 Jan. 1939 to 7 July 1943, I, 16–54.

11. Hist. AC Tech. Tng. from 1917 to 7 Dec. 1941, I, 1–23.

12. Hist. Maxwell Fld., 1 Jan. 1939–7 Dec. 1941, pp. 1–6.

13. House, Hearings before the Subcommittee of the Committee on Appropriations on the Supplementary Military Appropriations Bill for 1940, 76 Cong., 1 Sess., 17 May 1939, p. 46.

14. Hist. Chanute Fld., 1917–41, I, 48.

15. Ltr., Lt. Col. F. E. Galloway, CO AC Adv. Flying Sch., Maxwell Fld., to C/AC, 23 Sept. 1940; marginal comments by Col. F. M. Kennedy, C/Buildings and Grounds (B&G) Div., OCAC.

16. Hist. Acquisition of Facilities for the ASC, 1939–1944, pp. 1–17; R&R, Maj. H. S. Vandenberg to Col. Carl Spaatz, C/Plans Div., OCAC, 4 Sept. 1940.

17. OCAC Station List, 2 Mar. 1939; R&R, Col. R. B. Lincoln, C/Plans Sec., OCAC to C/Supply Div., OCAC, 11 Nov. 1937.

18. R&R cited in n. 17; memo for DC/S, Air from Brig. Gen. Carl Spaatz, C/AS AAF, 4 Sept. 1941; ltr., Lt. Col. M. F. Davis, Exec. OCAC to CG GHQ AF, 29 Sept. 1938, and 1st ind. thereto, Brig. Gen. W. G. Kilner, C/S GHQ AF to C/AC, 7 Oct. 1938.

19. OCAC Station List, 2 Mar. 1939; memo for C/AC from Col. Carl Spaatz, C/Plans Sec., OCAC, 14 Nov. 1939; Civil Aeronautics Authority (CAA), Airport Survey, pp. xv–xvi, 30; H. Doc. No. 245, 76 Cong., 1 Sess., 24 Mar. 1939.

20. AID, AC/AS-4, Summary of Real Estate and Construction Costs for AAF Installations, 16 Sept. 1946, p. 143.

21. Memo for AS/W from Maj. Gen. H. H. Arnold, 13 Jan. 1939.

22. Memo for C/S from Maj. Gen. H. H. Arnold, 18 Jan. 1939; Public Law 164, 76 Cong., 1 Sess., 53 *Stat.* 994, 1 July 1939.

23. Ltr., Maj. Gen. H. H. Arnold, C/AC to CO's all Air Corps stations, 6 Apr. 1939; ltr., Lt. Col. M. F. Davis, Exec. OCAC to CO's all Air Corps stations, 8 Feb. 1939.

24. House, Hearings before the Subcommittee of the Committee on Appro-

priations on the Supplementary Military Appropriations Bill for 1940, 76 Cong., 1 Sess., 17 May 1939, p. 24.

25. Hist. Br., OCE, Military Construction in the United States under the Direction of the Quartermaster General and the Chief of Engineers, I, 78–79, 86; ltr., Maj. Gen. H. H. Arnold, C/AC to CG GHQ AF, 18 Apr. 1939.

26. Memo for C/S from Maj. Gen. H. H. Arnold, 12 Oct. 1938; memo for C/S from Maj. Gen. H. H. Arnold, 28 Nov. 1938; ltr., TAG to Lt. Col. H. R. Harmon, 15 Oct. 1938; ltr., TAG to Lt. Col. H. R. Harmon, 31 Jan. 1939; WD, Immediate Release, 13 July 1939, Southeast Air Base and Air Deport Locations Announced; ltr., Gen. G. C. Marshall, C/S to D/BOB, 12 Aug. 1939.

27. WD, Immediate Release, 15 Sept. 1939, Northeast Air Base Location.

28. Memo for AC/S G-4 from Maj. Gen. Westover, 17 Nov. 1936; ltr., TAG to Brig. Gen. E. M. Shinkle, 5 Dec. 1936; R&R, Col. Carl Spaatz, C/Plans Sec., OCAC to Exec. OCAC, 22 June 1939.

29. Résumé, OCAC Div. Chiefs Mtg., 12 June 1939.

30. C/AC, Wkly. Rpt. to C/S, 7 Mar. 1940; R&R, Brig. Gen. B. K. Yount, C/Plans Div., OCAC to C/Training and Operations (T&O) Div., OCAC, 7 June 1940; C/AC, Wkly. Rpt. to C/S, 2 May 1940.

31. Hist. AAF Central Flying Training Command, 1 Jan. 1939–7 Dec. 1941, II, 168–84; Hist. AC Tech. Tng, from 1917 to 7 Dec. 1941, I, 92; ltr., TAG to C/AC, 12 Aug. 1939.

32. Ltr., C/AC to TAG, 15 Sept. 1939; Public Law 415, 76 Cong., 3 Sess., 54 *Stat.* 24, 12 Feb. 1940; Public Law 668, 76 Cong., 3 Sess., 54 *Stat.* 665, 27 June 1940.

33. Ltr., TAG to Lt. Col. H. M. McClelland, 8 Aug. 1939; ltr., Maj. Gen. H. H. Arnold, C/AC to TAG, 31 Jan. 1940; R&R, C/T&O Div., OCAC to Exec. OCAC, 16 Feb. 1940; ltr., Col. C. L. Tinker to TAG, 23 Apr. 1940; WD, Immediate Release, 7 June 1940, Acquisition of Bombing and Gunnery Ranges for the Army Air Corps; C/AC, Wkly. Rpt. to C/S, 29 Feb. 1940.

34. Ltr., TAG to C/AC, 24 Aug. 1939; R&R, Lt. Col. W. E. Farthing, Plans Div., OCAC to Col. Carl Spaatz, C/Plans Div., OCAC, 9 Sept. 1939; memo for C/AC from Col. Carl Spaatz, C/Plans Div., 14 Nov. 1939; ltr., H. H. Woodring, S/W to R. H. Hinckley, Chmn., CAA, 4 Jan. 1940.

35. Memo for AC/S G-3 from Brig. Gen. G. H. Brett, 11 July 1940.

36. Public Law 611, 76 Cong., 3 Sess., 54 *Stat.* 350, 13 June 1940; Public Law 667, 76 Cong., 3 Sess., 54 *Stat.* 599, 26 June 1940.

37. Ltr., TAG to C/AC, 29 June 1940; memo for C/S from Brig. Gen. B. K. Yount, AC/AC, 6 Aug. 1940.

38. Public Law 800, 76 Cong., 3 Sess., 54 *Stat.* 965, 8 Oct. 1940.

39. Memo for AC/S G-3 from Brig. Gen. G. H. Brett, Actg. C/AC, 11 July 1940.

40. Ltr., TAG to Chiefs, Arms and Services, 15 June 1940.

41. Memo for C/S from Maj. Gen. H. H. Arnold, C/AC, 24 May 1940, and 1st ind. thereto, TAG to C/AC, 6 June 1940; Public Law 611, 76 Cong., 3 Sess., 54 *Stat.* 350, 13 June 1940.

42. Hist. AAFFTC, 1 Jan. 1939–7 July 1943, I, 209–19.

43. Ltr., TAG to CO's Randolph, Maxwell, and Moffett Flds., 8 July 1940.

44. R&R, Brig. Gen. B. K. Yount, C/Plans Div., OCAC to C/B&G Div., OCAC 9 Sept. 1940; R&R, Brig. Gen. Carl Spaatz, C/Plans Div., OCAC to C/B&G Div., OCAC, 7 Mar. 1941.

45. Ltr., Maj. C. E. Duncan, Exec. OCAC to CO ACTS, 11 July 1940.

46. Ltr., Col. G. C. Brant, CO ACTS to C/AC, 15 July 1940; House, Hearings before the Subcommittee of the Committee on Appropriations on the Third Supplemental National Defense Appropriation Bill for 1941, 76 Cong., 3 Sess., 13 Sept. 1940, p. 54; ltr., TAG to CO Chanute Fld., 7 Sept. 1940; ltr., TAG to C/AC, 30 July 1940; ltr., TAG to C/AC, 21 Feb. 1941; Hist. AC Tech. Tng., 1917 to 7 Dec. 1941, I, 94, 97.

47. WD, Future Release, 26 Aug. 1940, Transfer of Air Corps Units.

48. C/AC Wkly. Rpts. to C/S, 3 July 1940, 19 Sept. 1940; telg., CO Hamilton Fld. to C/AC, 9 Sept. 1940.

49. WD, Immediate Release, 26 Sept. 1940, Changes in Stations for Air Corps Units.

50. Memo for AC/S WPD from Maj. Gen. H. H. Arnold, C/AC, 30 Aug. 1940; ltr., R. P. Patterson, AS/W to Col. D. H. Connally, Administrator, CAA, 19 Sept. 1940.

51. Public Law 812, 76 Cong., 3 Sess., 54 *Stat.* 1039, 9 Oct. 1940.

52. C/AC Wkly. Rpt. to C/S, 12 Dec. 1940; memo for AC/S, G-4 from Col. Robert Olds, Plans Div., OCAC, 24 March 1941.

53. Public Law 135, 77 Cong., 1 Sess., 55 *Stat.* 281, 28 June 1941.

54. Ltr., Col. C. W. Russell, C/S GHQ AF to C/Engrs., 2 Nov. 1940, and 1st ind. thereto, Brig. Gen. Carl Spaatz, C/Plans Div., OCAC to C/Engrs., 6 Nov. 1940.

55. R&R, C/Plans Div., OCAC to C/AC, 21 June 1940; memo for C/AC from C/Plans Div., OCAC, 2 July 1940; radg., Brig. Gen. B. K. Yount, Actg. C/AC to CG GHQ AF, 15 July 1940.

56. Memo for TAG from Brig. Gen. R. C. Moore, Asst. C/S G-4, 12 July 1940.

57. Memo for DC/S Air from Brig. Gen. G. H. Brett, C/AC, 19 June 1941.

58. Ltr., Col. Willis H. Hale to Maj. Gen. H. H. Arnold, 19 May 1941.

59. Hist. Br., OCE, Military Construction in the United States, II, 184.

60. Memo for AC/S G-3 from Brig. Gen. B. K. Yount, C/Plans Div., OCAC, 19 Aug. 1940; R&R, Brig. Gen. B. K. Yount, C/Plans Div., OCAC to C/B&G Div., OCAC, 18 Sept. 1940; C/AC, Wkly. Rpt. to C/S, 19 Dec. 1940.

61. Memo for Maj. B. B. Cassiday, B&G Div., OCAC from Capt. G. C. Updegraff, 7 Nov. 1940; ltr., Col. F. M. Kennedy, C/B&G Div., OCAC to TAG, 3 Feb. 1941.

62. Memo for Brig. Gen. R. C. Moore, AC/S G-4 from Col. F. M. Kennedy, C/B&G Div., OCAC, 15 Nov. 1940; Hist. Br., OCE, Military Construction in the United States, I, 102–29; Biennial Report of the Chief of Staff of the United States Army, 1 July 1941 to 30 June 1943, p. 47; H. Doc. No. 288, 78 Cong., 1 Sess.; WD OQMG, Constr. Div., Constr. Prog. Rpt., 30 Nov. 1941, p. 13.

63. R&R, Col. F. M. Kennedy, C/B&G Div., OCAC to Exec. OCAC, 8 July 1941.

64. Public Law 13, 77 Cong., 1 Sess., 55 *Stat.* 34, 17 Mar. 1941; WD, Immediate Release, 17 Feb. 1941, Savannah Air Base, First Completed Under Defense Construction Program.

65. Memo for AC/S G-4 from Lt. Col. A. R. Wilson, G-4 Div., WDGS, 9 June 1941; memo for DC/S Air from Maj. Gen. G. H. Brett, 19 June 1941; ltr., C/AC to TAG, 26 Feb. 1941; C/AC, Wkly. Rpt. to C/S, 7 Nov. 1940, 19 Dec. 1940; ltr., C/AC to TAG, 8 Jan. 1941, and 3d ind. thereto, TAG to C/AC, 8 Jan. 1941.

66. Hist. Dow Fld., Inception to 26 Feb. 1942, pp. 1–86.

67. Ltr., Lt. Gen. D. C. Emmons, CG GHQ AF to C/AC, 27 May 1941; ltr., Maj. Gen. G. H. Brett, C/AC to CG AFCC, 5 July 1941; min., mtgs, nos. 1-16, Interdepartmental Air Traffic Control Board.

68. OCAC, Policies Relative to Utilization of Airdrome Facilities by the Army Air Corps, 13 Feb. 1941; R&R, Col. F. M. Kennedy, C/B&G Div., OCAC to Exec. OCAC, 17 Feb. 1941.

69. Ltr., Lt. Col. V. V. Taylor, AG, Puerto Rican Dept. to CG 13th Comp. Wg., 9 Jan. 1941, and 4th ind. thereto, Maj. Gen. G. H. Brett, C/AC to TAG, 20 Feb. 1941; AAF Station List, 20 Sept. 1941.

70. Hist. AAFFTC, 1 Jan. 1939 to 7 July 1943, I, 102–8, 123; ltr., Lt. Gen. D. C. Emmons, CG GHQ AF to TAG, 20 Mar. 1941; memo for WPD from Brig. Gen. Carl Spaatz, C/Plans Div., 8 Apr. 1941.

71. Hist. AAFFTC, 1 Jan. 1939–7 July 1943, I, 112–13; Hist. AAF CFTC, 1 Jan. 1939–7 Dec. 1941, II, 190–97.

72. Ltr., Maj. Gen. G. H. Brett, Actg. C/AC to TAG, 17 Jan. 1941; R&R, Brig. Gen. Carl Spaatz, C/Plans Div., OCAC to Exec. OCAC, 2 Jan. 1941; Public Law 13, 77 Cong., 1 Sess., 55 *Stat.* 34, 17 Mar. 1941.

73. Memo for C/AC from Col. S. J. Chamberlin, C/Constr. Br., AC/S G-4, 6 Mar. 1941; Hist. Acquisition of Facilities for the ASC, 1939–1944, pp. 48–55.

74. Ltr., TAG to CG GHQ AF and C/AC, 14 Mar. 1941.

75. Memo for C/AC from Col. S. J. Chamberlin, C/Constr. Br., AC/S G-4, 6 Mar. 1941; R&R, C/Plans Div., OCAC to C/T&O Div., OCAC, 22 Mar. 1941; ltr., TAG to C/AC, 26 Mar. 1941.

76. R&R, C/Plans Div. to Exec. OCAC, 11 Apr. 1941; Public Law 29, 77 Cong., 1 Sess., 55 *Stat.* 123, 5 Apr. 1941; ltr., Gen. G. C. Marshall, C/S to Adm. H. R. Stark, 8 May 1941; Public Law 210, 77 Cong., 1 Sess., 55 *Stat.* 624, 16 Aug. 1941.

77. Hist. AAFFTC, 1 Jan. 1939–7 July 1943, I, 181–82; Hist. WCACTC, 8 July 1940–7 Dec. 1941, I, 152–67; Hist. AAF CFTC, 1 Jan. 1939–7 Dec. 1941, II, 197–200, 231–38; Hist. AAF EFTC, 1 Jan. 1939–7 Dec. 1941, I, 86–98, 226.

78. Hist. AAF CFTC, 1 Jan. 1939–7 Dec. 1941, II, 250–59; Hist. WCACTC, 8 July 1940–7 Dec. 1941, I, 193–94, 206; Hist. AAF EFTC, 1 Jan. 1939–7 Dec. 1941, I, 307–8, 553–54; Hist. AAF EFTC, 7 Dec. 1941–1 Jan. 1943, II, 824.

79. Ltr., Brig. Gen. R. B. Lincoln, CO ACTS to C/AC, 10 Jan. 1941; R&R, C/Plans Div., OCAC to C/B&G Div., OCAC, 18 Feb. 1941; memo for AC/S G-4, FWA Br. from Col. Robert Olds, Plans Div., OCAC, 31 Mar. 1941; memo for C/S from Lt. Col. M. S. Fairchild, Exec., Plans Div. OCAC, 15 May 1941; ltr., TAG to C/AC, 6 June 1941.

80. Hist. AC Tech. Tng., 1917 to 7 Dec. 1941, I, 23–29.

81. R&R, C/Mat. Div., OCAC to C/Plans Div., OCAC, 2 July 1941.

82. Ltr., TAG to Lt. Col. C. C. Nutt, AC Maint. Comd., 17 June 1941; memo for S/W from Maj. Gen. H. H. Arnold, C/AAF, 10 Sept. 1941.

83. Hist. San Bernardino Air Depot, Activation to 31 Dec. 1943, II, 104, 109; Hist. Spokane ASC, 1942–43, I, 26–27, 51.

84. Ltr., Maj. Gen. G. H. Brett, Actg. C/AC to AC/S G-4, 1 May 1941; memo for C/S from Maj. Gen. G. H. Brett, Actg. C/AC, 7 May 1941; ltr., TAG to C/AC, 11 July 1941; R&R, Brig. Gen. Carl Spaatz, C/AS AAF to C/AAF, 30 July 1941; ltr., Col. F. S. Brady, C/S 3d AF to Col. J. W. S. Wuest, 2 Aug. 1941, and 1st ind. thereto, Col. J. W. S. Wuest to C/AC, 4 Aug. 1941.

85. R&R, Col. F. M. Kennedy, C/B&G Div., OCAC to Exec. OCAC, 8 July 1941; ltr., Col. D. McCoach, Asst. Exec. OCE to C/AC, 26 July 1941, and 1st ind. thereto, Col. F. M. Kennedy, C/B&G Div., OCAC to C/Engrs., 5 Aug. 1941.

86. Memo for C/AS AAF from Lt. Col. H. L. George, 22 Nov. 1941; House, Hearings before the Subcommitee of the Committee on Appropriations on the Third Supplemental National Defense Appropriation Bill for 1942, 77 Cong., 1 Sess., 17 Nov. 1941, pt. 2, pp. 75, 208–27, 234–36, 242; Senate, Hearings before the Subcommittee of the Committee on Appropriations on H.R. 6159, 77 Cong., 1 Sess., 11 Dec. 1941, pt. 2, pp. 327–30; Public Law 353, 77 Cong., 1 Sess., 55 *Stat.* 810, 17 Dec. 1941.

87. Ltr., TAG to C/AAF, AC/S G-4, 12 Sept. 1941.

88. R&R, Maj. Gen. H. H. Arnold, C/AAF to Brig. Gen. Carl Spaatz, C/AS AAF, 25 Nov. 1941; chart, Tng. and Opns. Factors, *ca.* 27 Nov. 1941.

89. Memo for C/S from Col. E. P. Sorenson, AC/AS A-4, 8 Dec. 1941; memo for C/Engrs. from C/B&G Div., OCAC, 20 Dec. 1941; ltr., Col. E. P. Sorenson, AC/AS A-4 to C/Engrs., 1 Jan. 1942; ltr., TAG to C/Engrs., C/AC, 31 Dec. 1941; memo for C/AC from Col. W. J. Reed, C/B&G Div., 6 Feb. 1942.

90. WD, Immediate Release, 7 June 1940, Acquisition of Bombing and Gunnery Ranges for Army Air Corps; memo for TAG from Col. F. M. Kennedy, C/B&G Div., OCAC, 1 Dec. 1940; Public Law 13, 77 Cong., 1 Sess., 55 *Stat.* 34, 17 Mar. 1941; ltr., CG AFCC to C/AC, 24 July 1941.

91. Memo for C/S from C/AC, 8 Oct. 1940; Exec. Order No. 8578, 29 Oct. 1940; R&R, Col. F. M. Kennedy, C/B&G Div., OCAC to C/Plans Div., OCAC, 28 Dec. 1940; memo for C/AC from Lt. Col. F. V. H. Kimble, Plans Div., OCAC, 5 May 1941; memo for C/AAF from Brig. Gen. M. S. Fairchild, Exec. OCAC, 2 Dec. 1941.

92. Memo for C/AAF from Col. W. J. Reed, C/B&G Div., OCAC, 31 Jan. 1942; Hist. Luke Fld., Activation to 8 Dec. 1941, I, 63–65.

93. Hist. Hq. 2d AF and Northwest Air Dist., Activation to 6 Dec. 1941, I,

208-12; Orgn. and Functions of the 4th AF thru the Year 1941, I, 211.

94. R&R, C/Plans Div., OCAC to C/AC, 5 July 1940; memo for C/S from Col. H. L. Twaddle, Actg. AC/S G-3, 26 Nov. 1940.

95. R&R, Col. F. M. Kennedy, C/B&G Div., OCAC to C/AAF, 13 Aug. 1941; ltr., TAG to QMG, 18 Sept. 1940; memo for Maj. Gen. H. H. Arnold from Maj. Gen. J. F. Williams, C/NG Bur., 28 Mar. 1941.

96. R&R, Brig. Gen. Carl Spaatz, C/Plans Div., OCAC to C/B&G Div., OCAC, 15 Apr. 1941. These stations were at Wheeler-Sack Field, Pine Camp, N.Y.; Otis Field, Falmouth, Mass.; Reilly Field, Ft. McClellan, Ala.; New Cumberland, Pa.; Detrick Field, Frederick, Md.; Lexington County Airport, Columbia, S.C.; Birmingham, Ala.; Esler Field, Camp Beauregard, La.; Chicago, Ill.; Adams Field, Little Rock, Ark.; Brownwood, Tex.; Sherwood Field, Paso Robles, Calif.; New Municipal Airport, San Antonio, Tex.; Jacksonville, Fla.; Ft. Dix, N.J.; Ft. Devens, Mass.; Abilene, Tex.; Vichy, Mo.; Northern Field, Tullahoma, Tenn.; Hattiesburg, Miss.; Alexandria, La.; and Kellogg Field, Battle Creek, Mich.

97. Ltr., Col. J. R. Johnson to TIG, 15 Nov. 1940; ltr., Maj. Gen. G. H. Brett, C/AC to TAG, 5 May 1941; memo for C/AC from Brig. Gen. H. A. Dargue, C/Inspection Div., OCAC, 4 June 1941.

98. Ltr., TAG to C/AAF, 25 July 1941; ltr., Maj. Gen. H. H. Arnold, C/AAF to CG AFCC, 26 July 1941; AFCC GO 34, 30 Aug. 1941; Hist. 2d AF, 7 Dec. 1941-31 Dec. 1943, II, 472.

99. Admin. Hist. Ferrying Comd., 29 May 1941 to 30 June 1942, pp. 1-13, 45; Origins of the Ferrying Div., ATC, May 1941 to Dec. 1941, pp. 92-97, 144-45.

100. Daily Diary, AID, 26 Sept. 1945, pp. 2-3.

101. Min. AAF Staff mtg., 9 Dec. 1941; memo for C/AC from Col. E. P. Sorenson, AC/AS A-4, 13 Dec. 1941.

102. Ltr., TAG to CG Eastern Theater of Opns., 20 Dec. 1941; ltr., TAG to CG Western Defense Comd., 12 Jan. 1942.

103. Hist. Br., OCE, Military Construction in the United States, II, 154-59.

104. *Ibid.;* ltr., TAG to C/AC, 4 Mar. 1942; ltr., Brig. Gen. L. P. Whitten, D/Base Services (AFRBS) to Engr. Bd., 16 Dec. 1942; ltr., TAG to CG's defense comds., 5 Mar. 1943; ltr., Col. J. C. Shively, B&G Sec., AC/AS MM&D to CG 4th AF, 23 Sept. 1943, and 2d ind. thereto, 25 Oct. 1943.

105. Hist. I Ftr. Comd., Dec. 1941-July 1944, II, app. A-5; ltr., CG Eastern Theater of Opns. to CG's I, II, and III Corps Areas, 31 Jan. 1942.

106. Orgnl. Development, Northeast Air Dist. and 1st AF, 19 Nov. 1940-31 Dec. 1943, pp. 41-42.

107. Station List, 1 May 1943, sec. II, p. 2. These fields were: main base–Baltimore, Md. Subbases–Republic Fld., Farmingdale, N.Y.; Dover, Del.; Bridgeport Fld., Stratford, Conn.; Norfolk, Va.; La Guardia Fld., N.Y. City; Andrews Fld., Camp Springs, Md.; Rentschler Fld., Hartford, Conn.; New Bedford, Mass.; Bluethenthal Fld., Wilmington, N.C.; Suffolk County Airport, West Hampton Beach, N.Y.; Philadelphia, Pa.; New Haven, Conn.; Green Fld., Providence, R.I.; Millville, N.J.; and Groton, Conn. Auxiliary fields–Westchester County Airport, Rye Lake, N.Y.; Salisbury, Md.; Brainard Fld., Hartford, Conn.; Hyannis, Mass.; and Portsmouth, N.H.

108. At the height of its operations the Antisubmarine Command operated from Drew; Grenier; Westover; Mitchel; Fort Dix; Dover; Langley; Bluethenthal; Charleston, S.C.; Chatham Field at Savannah, Ga.; Jacksonville, Fla.; the 36th St. Airport, Miami, Fla.; the Boca Chica Naval Air Station (NAS) at Key West, Fla.; Gulfport, Miss.; and Galveston, Tex. fields. (Ltr. Col. J. B. Newman, AFRBS to CG Antisubmarine Comd., 5 Nov. 1942.)

109. R&R, Exec., D/Air Defense (AFRAD) to AFRBS, 30 Mar. 1942; R&R, Brig. Gen. L. P. Whitten, AFRBS to AC/AS Tng. (AFACT), 23 Apr. 1942; R&R, AFACT to AFRBS, 4 June 1942; ltr., Col. J. B. Newman, AFRBS to CG Central Defense Comd., 24 June 1942.

110. Hist. 2d AF, 7 Dec. 1941-31 Dec. 1942, I, 6-7; Orgn. and Functions of the 4th AF, 1942-1945, I, 13-14, 27.

111. These Army airfields were: subbases–Grand Central Airport, Glendale,

Calif.; Mines Fld., Los Angeles, Calif.; Van Nuys Metropolitan Airport, Calif.; Orange County Airport, Santa Ana, Calif.; San Nicholas Island, Calif.; Lomita Flight Strip, Calif.; Oxnard Flight Strip, Calif.; Kearney Mesa NAS, San Diego, Calif.; Otay Mesa NAS, San Diego, Calif.; Lindbergh Fld., San Diego, Calif.; Concord, Calif.; Oakland Municipal Airport, Calif.; San Francisco Municipal Airport, Calif.; Half Moon Bay Flight Strip, San Mateo, Calif.; Oroville, Calif.; Santa Rosa, Calif.; Hayward, Calif.; Sacramento Municipal Airport, Calif.; Bakersfield, Calif.; Visalia, Calif.; Delano, Calif.; Portersville, Calif.; Bishop, Calif.; Palmdale, Calif.; Salem, Ore.; Bellingham, Wash.; Arlington NAS, Ore.; Mt. Vernon NAS, Ore.; Oak Harbor NAS, Wash.; Olympia, Wash.; Shelton NAS, Wash.; Kitsap County NAS, Wash.; Ellensburg, Wash.; Port Angeles, Wash.; Boeing Fld., Seattle, Wash.; South Bend Airfield, Willipa, Wash.; Ontario, Calif.; and Quillayute NAS, Wash. Auxiliary fields—Minden, Nev.; Needles, Calif.; Ream Fld. NAS, San Diego, Calif.; Napa, Calif.; Eureka NAS, Calif.; Willows, Calif.; Winters-Davis Flight Strip, Calif.; Eugene, Ore.; Hillsboro, Ore.; McMinnville, Ore.; Aurora Flight Strip, Ore. (AAF Station List, 1 May 1943, sec. II, p. 5.)

112. Memo for Col. H. S. Vandenberg, AC/AS Plans from Lt. Col. Monro MacCloskey, 28 Apr. 1942; ltr., Col. H. B. Sepulveda, AG 1st AF to CG AAF, 28 Apr. 1942; R&R, AFRBS to Bud. and Fisc. Off., AAF, 17 June 1942.

113. Public Law 664, 77 Cong., 2 Sess., 56 *Stat.* 492, 2 July 1942; AAF Station List, 4 Nov. 1943, sec. III.

114. Min. Air Staff mtg., 23 Dec. 1941; memo for C/S from Lt. Gen. H. H. Arnold, C/AAF, 2 Jan. 1942; memo for C/S from Lt. Col. C. E. Duncan, 3 Jan. 1942; ltr., TAG to C/AAF, 19 Jan. 1942; memo for C/AAF from Col. H. A. Craig, Actg. AC/AS AWPD, 29 Jan. 1942; directive memo for A-1, *et al.* from Col. J. Y. York, 5 Feb. 1942; memo for Giles from Col. J. L. Loutzenheiser, C/Opnl. Plans Div., AC/AS Plans, 10 Dec. 1943; memo for Stratemeyer from Arnold, CG AAF, 17 Dec. 1942; memo for all concerned from Arnold, CG AAF, 5 Jan. 1943.

115. Memo for AC/AS A-4 from Col. O. A. Anderson, AC/AS Plans, 6 July 1942.

116. R&R, Col. L. P. Whitten, AFRBS to C/AS, 26 Oct. 1942; R&R, Brig. Gen. T. J. Hanley, DC/AS to AFRBS, 31 Oct. 1942; memo for AC/AS A-4 from Col. J. B. Newman, AFRBS, 29 Oct. 1942; ltr., Newman, AFRBS to CG 2d AF, 5 Nov. 1942.

117. Ltr., Arnold, CG AAF to CG AFCC, 17 Jan. 1942; R&R, Stratemeyer AC/AS A-4 to AC/AS AWPD, 27 Jan. 1942.

118. Hist. Br., OCE, Military Construction in the United States, I, 43; ltr., Col. J. B. Cooley, Asst. AAG to C/AC, 6 Feb. 1942; Hist. 2d AF, 7 Dec. 1941–31 Dec. 1942, II, 406.

119. Ltr., TAG to CG AAF, 1 June 1942.

120. WD Cir. #59, 2 Mar. 1942; ltr., Brig. Gen. W. D. Styer, C/S SOS to C/Engrs., 23 Mar. 1942.

121. AHS-10, Organization of the Army Air Arm, 1935–1943, pp. 64, 102–5.

122. AAF Reg. #85–3, 25 Apr. 1942; Hist. Br., OCE, Military Construction in the United States, II, 160.

123. Rcd. of telephone conversation, Brig. Gen. M. S. Fairchild, D/Mil. Requirements (AFDMR) to Maj. Gen. Robert Olds, CG 2d AF, 1 July 1942; ltr., Col. W. W. Dick, AAG to CG's all air forces and commands, 14 Sept. 1942.

124. Hist. AAFFTC, 1 Jan. 1939–7 July 1943, II, 342–50.

125. Hist. AAF EFTC, 7 Dec. 1941–1 Jan. 1943, I, 83–86, 123–39; Hist. AAF CFTC, 7 Dec. 1941–31 Dec. 1942, II, 167–96; Hist. WCTC, 7 Dec. 1941–31 Dec. 1942, I, 35–55, 145.

126. Hist. AAF EFTC, 7 Dec. 1941–1 Jan. 1943, I, 74–77, 86–91, 119–23, 140–53, 181–257, 271, 374, 401–3, 512–13; Hist. AAF CFTC, 7 Dec. 1941–31 Dec. 1942, II, 131–60, 197–217; Hist. WCTC, 7 Dec. 1941–31 Dec. 1942, I, 43–97, 263, 267.

127. Ltr., TAG to CG's AFCC, SEACTC, and WCACTC, 6 Dec. 1941; Hist. AAF EFTC, 7 Dec. 1941–1 Jan. 1943, I, 512–13.

128. Hist. AAFFTC, 1 Jan. 1939–7 July 1943, I, 294–306.

129. Hist. AAFTTC and its Predecessors, 1 Jan. 1939–7 July 1943, II, 223–41; ltr., Col. W. W. Dick, AAG to C/AC, 31 Jan. 1942; ltr., Col. W. W. Dick, AAG to C/Engrs., 31 Jan. 1942.

130. WD OCE, Quarterly Inventory; Owned, Sponsored and Leased Facilities, 30 Sept. 1945, pp. 24, 46–47, 49, 73, 75, 77. Not all of this expense, however, was attributable to the Technical Training Command; by this date both Gulfport and Seymour-Johnson had been used for tactical purposes.

131. Hist. AAFTTC and its Predecessors, 1 Jan. 1939–7 July 1943, II, 299–304.

132. *Ibid.*, II, 299–301; V, 712.

133. *Ibid.*, II, 278–79.

134. S. Report No. 10, 78 Cong., 2 Sess., 3 Mar. 1944, pt. 16, p. 124.

135. Hist. Chicago Schs., 4 Sept. 1942–3 Nov. 1943, I, 1–26; Hist. AAF Weather Tng. Cen., 21 Nov.–31 Dec. 1942, pp. 16, 128–34.

136. AAF Station List, 1 May 1943, sec. II, pp. 11–12.

137. S. Report No. 10, 78 Cong., 2 Sess., 3 Mar. 1944, pt. 16, p. 124; memo for rcd. from Brig. Gen. E. S. Perrin, DC/AS, 11 July 1943.

138. Radg., Maj. Gen. F. L. Martin, CG 2d AF to CG AAF, 1 Apr 1942; ltrs., Col. L. P. Whitten, AFRBS to CG SOS, 6 and 7 Apr. 1942.

139. Ltr., Brig. Gen. Robert Olds, CG 2d AF to CG AAF, 23 May 1942; ltr., Brig. Gen. M. S. Fairchild, AFDMR to CG 2d AF, 11 June 1942; memo for CG 2d AF from Stratemeyer, C/AS, 8 July 1942.

140. Hist. 2d AF, 7 Dec. 1941–31 Dec. 1942, II, 420–22, 435–36, 480–81; ltr., Maj. Gen. Robert Olds, CG 2d AF to CG AAF, 9 Sept. 1942, and 1st ind. thereto, Col. E. C. Itschner, Asst. C/Opns. Br., Constr. Div., OCE to AC/AS A-4, 3 Oct. 1942.

141. Ltrs., Maj. Gen. Robert Olds, CG 2d AF to CG AAF, 30 Nov. 1942 and 18 Jan. 1943.

142. Hist. 2d AF, 1943, I, 129–55.

143. Hist. Br., OCE, Military Construction in the United States, II, 258.

144. Hist. 3d AF, Activation to 30 June 1944, I, 315; AAF Station List, 1 May 1943, sec. II, p. 4.

145. Memo for rcd. by Stratemeyer, C/AS AAF and Rear Adm. J. H. Towers, C/BuAer, USN, 19 Sept. 1942.

146. Memo for CG AAF from Maj. Gen. R. E. Porter, AC/S G-3, 4 Feb. 1944; ltr., CG 3d AF to CG AAF, 27 Feb. 1943.

147. Training of Troop Carrier Air Echelons, pt. 1, pp. 1, 10–14; ltr., Lt. Col. P. M. Whitney, Asst. AAG to C/AC, 20 Feb. 1942; ltr., Brig. Gen. F. S. Borum, CG I TTC to CG AAF, 27 Feb. 1943.

148. Hist. I Concentration Comd., I, bk. 2, *passim.*

149. Memo for Col. W. J. Reed, C/B&G Div., OCAC from Col. W. E. Lynd, Air Support Sec., AFCC, 27 Jan. 1942.

150. Ltr., Col. L. P. Whitten, AFRBS to C/Engrs., 14 Apr. 1942; Hist. 3d AF, Activation to 30 June 1944, I, 164–220; AAF Installations Directory, 1 July 1944, sec. I, pp. 9, 23. During 1942–43 the following comprehensive Army post-airfield relationship was completed:

Camp Edwards, Mass.	Otis Field, Falmouth, Mass.
Ft. Devens, Mass.	Ft. Devens Army Airfield, Ayer, Mass.
Indiantown Gap Reservation, Pa.	New Cumberland and Reading Army Airfields, Pa.
Ft. Dix, N.J.	Ft. Dix Army Airfield, Wrightstown, N.J.
Ft. Bragg, N.C.	Pope Field
Camp Pickett, Va.	Blackstone Army Airfield, Va.
Camp Blanding, Fla.	Alachua Army Airfield, Gainesville, Fla., and Keystone Hgts. Army Airfield, Fla.
Camp Butner, N.C.	Raleigh-Durham Army Airfield, N.C.
Camp Gordon, Ga.	Aiken Army Airfield, S.C.
Camp Atterbury, Ind.	Camp Atterbury Army Airfield, Ind.
Camp Breckenridge, Ky.	Camp Breckenridge Army Airfield, Ky.

Ft. Custer, Mich.	Kellogg Field, Battle Creek, Mich.
Camp Gruber, Okla.	Muskogee Army Airfield, Okla.
Ft. Riley, Kans.	Marshall Field
Camp Howze, Tex.	Gainesville Army Airfield, Tex.
Camp J. T. Robinson, Ark.	Adams Field, Little Rock, Ark.
Ft. Leonard Wood, Mo.	Vichy Army Airfield, Mo.
Camp Carson, Colo.	Peterson Field, Colorado Springs, Colo.
Camp Maxey, Tex.	Legion Field, Paris, Tex.
Camp Swift, Tex.	Alamo Army Airfield, San Antonio, Tex.
Camp Hood, Tex.	Killeen Field, Temple, Tex.
Ft. McClellan, Ala.	Birmingham Army Airfield, Ala.
Camp Rucker, Ala.	Ozark Army Airfield, Ala.
Camp Forrest, Tenn.	Northern Field, Tullahoma, Tenn.
Camp McCain, Miss.	Grenada Army Airfield, Miss.
Camp Shelby, Miss.	Hattiesburg and Laurel Army Airfields, Miss.
Ft. Sill, Okla.	Post Field
Camp Davis, N.C.	Camp Davis Army Airfield, Wilmington, N.C.
Camp Barkley, Tex.	Abilene Army Airfield, Tex.
Ft. Bliss, Tex.	Biggs Field
Ft. Huachuca, Ariz.	Hereford Army Airfield, Ariz.
Ft. Ord, Calif.	Salinas Army Air Field, Calif.
Camp Beale, Calif.	Marysville Army Air Field, Calif.
Camp San Luis Obispo, Calif.	Estrella Army Air Field, Calif.
Camp Adair, Ore.	Corvallis Army Air Field, Ore.
Camp White, Ore.	Medford Army Air Field, Ore.
Ft. Lewis, Wash.	Gray Field
Ft. Jackson, S.C.	Congaree Army Air Field, S.C.
Ft. Benning, Ga.	Lawson Field
Pine Camp Reservation, N.Y.	Wheeler-Sack Field, Watertown, N.Y.
Camp Campbell, Ky.	Camp Campbell Army Air Field, Ky.
Camp Cooke, Calif.	Santa Maria Army Air Base, Calif.
Camp Hulen, Tex.	Palacios Army Air Field, Tex.
Camp Polk, La.	De Ridder Army Air Field, La.
Camp Claiborne and Camp Beauregard, La.	Esler Field and Alexandria Army Air Field, La.
Ft. Knox, Ky.	Godman Field

In the Desert Training Center maneuver area airfields were built at Blythe, Desert Center, Rice, Shavers Summit, and Thermal, Calif.

151. Memo for C/S from Maj. Gen. M. F. Harmon, C/AS, 2 July 1942; memo for AC/S G-3 from Col. D. M. Schlatter, D/Air Support, 8 Aug. 1944.

152. Hist. AAF Mat. Comd., 1942, pp. 86, 164-71; WD OCE, Quarterly Inventory: Owned, Sponsored and Leased Facilities, 30 Sept. 1945, p. 214.

153. Hist. Acquisition of Facilities for the ASC, 1939-1944, pp. 73-110, 117, 162.

154. Admin. Hist. Ferrying Comd., 29 May 1941-30 June 1942, pp. 45, 67-130; Hist. Ferrying Div., ATC, 20 June 1942-14 Feb. 1943, p. 25; Admin. Hist. ATC, June 1942-Mar. 1943, pp. 22-79; Origins of the Ferrying Division, ATC, Jan. thru June 1942, pp. 461, 474, 498, 508, 513, 516; R&R, Maj. Gen. H. L. George, CG ATC to AC/AS Plans, 27 Feb. 1943.

155. Hist. AAF Proving Ground Comd., pt. I: Hist. Outline, pp. 39, 43, 51, 64, 66; *ibid.*, pt. II: Origin and Growth, Acquisition of Land, p. 2; *ibid.*, Army-Navy Relationships and Jurisdiction, 1938-June 1946, *passim.*

156. Hist. Ftr. Comd. Sch., 28 Mar.-5 Nov. 1942, I, 98, 114, 120-28, 260-74; Training and Testing at AAFSAT, Air Defense, Nov. 1942-Oct. 1943, I, 115-25; Hist. Air Support Dept., AAFSAT, 5 Nov. 1942-29 Oct. 1943, I, 124-58; Training and Testing at AAFSAT, Bombardment, Nov.

1942–Oct. 1943, I, 60–75; Training and Testing at AAFSAT, Air Service, Nov. 1942–Oct. 1943, I, 25.

157. Memo for AS/W from Maj. Gen. O. P. Echols, AC/AS MM&D, 14 June 1943.

158. Hist. 2d AF, 7 Dec. 1941–31 Dec. 1942, I, 125–30; *ibid.*, 1943, II, 389–99.

159. AAF Installations Directory, 1 Oct. 1943, sec. IV; AAF Station List, 4 Nov. 1943, sec. I.

160. AAF Installations Directory, 1 Oct. 1943, sec. IV; Hist. AAFFTC and Its Predecessors, 1 Jan. 1939–7 July 1943, VI, 1,670–71.

161. Memo for AS/W from Maj. Gen. O. P. Echols, AC/AS MM&D, 14 June 1943; memo for AC/AS MM&D from R. A. Lovett, AS/WA, 29 June 1943; memo for AS/W from Brig. Gen. B. E. Styers, Actg. AC/AS MM&D, 21 Sept. 1943; memo for AC/AS MM&D from Maj. A. M. Hanson, Asst. Exec., OAS/WA, 1 Oct. 1943.

162. Daily Diary, AID, 26 Sept. 1945, pp. 2–3.

163. AC/AS Plans, Notes for General Conf., 15 Jan. 1943; TAG memo #W100-7-43, 2 Apr. 1943; TAG memo #W100-10-43, 15 Apr. 1943; ltr., Col. F. C. Milner, AAG to CG's all air forces and commands, 15 May 1943; ASF, Annual Rpt., FY 1944, p. 181; ltr., Arnold, CG AAF to CG's all air forces and commands, 14 Jan. 1944; Daily Diary, Air Services Div. (ASD), AC/AS MM&D, 16 Feb. 1944; R&R, Maj. Gen. B. M. Giles, C/AS to Brig. Gen. H. S. Vandenberg, DC/AS, 27 Feb. 1944.

164. ASF, Annual Rpt., FY 1945, pp. 290–91; Hist. 1st AF, Tng., Jan.-Dec. 1944, pp. 1–5, 42–49; Ftr. Tng. in the 4th AF, 1942–1945, I, 20–39; Bomb. Tng. in the 4th AF, 1942–1945, I, 191–201; Hist. 3d AF, Flying Tng., 1941–1944, I, 177–88; Hist. 2d AF, 1943, I, 1, 29–32.

165. Hist. 2d AF, 1943, I, 22–24, 37, 167; *ibid.*, 1944, II, 426–33; Daily Diary, AID, 26 Oct. 1944, pp. 5–6; Daily Diary, ASD, 1 May 1944, p. 3, 25 Sept. 1944, pp. 7–8.

166. Hist. AAF Tng. Comd., 7 July 1943–31 Dec. 1944, IV, 898; Hist. 3d AF, 1 Oct.–31 Dec. 1944, I, 57–65; Bomb. Tng. in the 4th AF, 1942–1945, I, 161–75.

167. Hists. Pacific Overseas Air Service Command to 1 July 1944, I, 147–57; 1 July–30 Sept. 1944, pp. 12–21; Daily Diary, AID, 16 Jan. 1945, p. 2.

168. Daily Diary, AC/AS MM&D, 20 Sept. 1944; Daily Diary, AC/AS M&S, 27 Apr. 1945; Daily Diary, ASD, 1 Oct. 1945, pp. 3–4.

169. Memo for CG's AAF, AGF, ASF from Maj. Gen. R. H. Porter, AC/S G-3, 1 Dec. 1943; WD Cir. #8, 5 Jan. 1944.

170. Hist. AAF Tng. Comd., 7 July 1943–31 Dec. 1944, I, 1–8, VII, 1,790–91; *ibid.*, 1939 to V-J Day, I, 85–89; Daily Diary, AID, 26 Sept. 1945, pp. 2–3.

171. Memo for C/AS from Brig. Gen. L. P. Whitten, AC/AS MM&D, 12 Nov. 1943; ltr., Brig. Gen. E. S. Perrin, DC/AS to AS/WA, 22 Mar. 1944; AAF Ltr. 85-3, 15 Sept. 1944; ASF, Annual Rpt., FY 1945, p. 296.

172. Ltr., Brig. Gen. E. S. Perrin, DC/AS to CG ASC, 9 Dec. 1943; Daily Diary, AID, 1 July 1944, p. 2; 3 Aug. 1944, p. 6; 24 Aug. 1944, p. 5; 8 Feb. 1945, p. 3; 13 Sept. 1945, p. 3; 21 Sept. 1945, p. 4.

173. Daily Diary, AID, 27 Dec. 1945, 14 Jan. 1946.

174. Orgn. and Functions of the 4th AF, 1942–1945, I, 78–88, 201–6.

175. AAF Stat. Digest, p. 313.

176. Hist. Granada Army Air Field, July 1942–June 1944, pp. 2, 31, 35.

NOTES TO CHAPTER 5

1. Public Law 446, 69 Cong.; Bud. Off., MD, OCAC, Aircraft by Type–Report No. 4A1D, 22 Aug. 1939.

2. Final Rpt. of the WD Sp. Com. on Army Air Corps, 18 July 1934, p. 31; Public Law 755, 74 Cong.

3. Rudolf Modley, ed., *Aviation Facts and Figures 1945* (New York, 1945), p. 55.

4. Aircraft by Type, as cited in n. 1. For a discussion of Roosevelt's attitude, see Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations* (Washington, 1950), pp. 131–34 and Robert E. Sherwood, *Roosevelt and Hopkins* (New York, 1948), p. 100.

5. Public Law 528, 75 Cong.

6. Memo for AS/W from Arnold, 10 Nov. 1938; Watson, pp. 134–36; House, Hearings on Supplementary Military Ap-

propriations Bill for 1940, 76 Cong., 1 Sess., p. 54.

7. Watson, *Chief of Staff*, pp. 136–38.

8. Memo for C/S from Louis Johnson, Actg. S/W, 15 Nov. 1938; memo for C/S from Brig. Gen. George V. Strong, AC/S WPD, 18 Nov. 1938; Watson, pp. 142–43; incl. to memo for C/MD from Arnold, 29 Nov. 1938; memo for C/S from Arnold, 28 Nov. 1938; memo for C/AS from TAG, 11 Jan. 1939.

9. *Cong. Rec.*, 76 Cong., 1 Sess., p. 218 ff.

10. Public Law 18, 76 Cong.

11. Public Law 44, 76 Cong.; Public Law 164, 76 Cong.; Public Law 18, 76 Cong.; House, Hearings . . . 1940 [H.R. 6791], 76 Cong., 1 Sess., pp. 4, 6, 7, 23.

12. *New York Times*, 17 Jan. 1939, p. 6.

13. Strength Rpts., Army Air Corps, 31 Dec. 1938, 31 Aug. 1939; memo for Hon. Andrew J. May, Chmn., Mil. Affairs Com., H.R. from C/S, 11 Feb. 1939; Bud. Off., MD, WD Sp. Quarterly Rpt. of Airplanes, 30 Sept. 1939; Annual Rpt. of C/AC, FY 1939, chart, pp. 24–25; House, Hearings . . . 1940, 76 Cong., 1 Sess., p. 22.

14. British Air Ministry, The Rise and Fall of the German Air Force, 1933 to 1945 (London, 1948), pp. 21, 28; R&R, Lt. Col. Ira C. Eaker, Exec. OCAC to Plans Sec. OCAC, 6 Mar. 1939; Air Estimates 1939, HMSO London, 1939, p. 5. As of April 1939 the RAF had 96,000 officers and men and planned an increase to 118,000 during the next 12 months.

15. The Rise and Fall of the GAF, pp. 26, 38.

16. Report of the Secretary of War, Fiscal Year 1939, p. 56.

17. WD Sp. Quarterly Rpt. . . . , 30 Sept. 1939.

18. Rpt. of S/W, FY 1938, pp. 26–27; *Cong. Rec.*, 76 Cong., 1 Sess., p. 219.

19. Miscellaneous Data for Use in Connection with the 5,500 Airplane Program, n.s., n.d., but by Lt. Col. W. F. Volandt, 1939; *Jane's All the World's Aircraft, 1939* (London, 1940), pp. 102c–6c; Tech. Data Br., MD, Characteristics and Performance of U.S. Army Airplanes, 1 July 1939; Intel. Sec., Info. Div., OCAC, Outstanding Airplanes—World Air Powers as of 30 June 1938, 16 Jan. 1939.

20. Charac. U.S. Army Airplanes, as cited in n. 19; *Jane's 1939*, pp. 100c–101c, 142c–44c.

21. Charac. U.S. Army Airplanes, cited in n. 19; Outstanding Airplanes, cited in n. 19; WD Sp. Quarterly Rpt., 30 Sept. 1939.

22. Ltr., S/W to Hon. Carl Vinson, House, 5 July 1941; ltr., Arnold to TAG, 14 Apr. 1939; memo for C/S from Arnold, 10 May 1939.

23. Final Rpt., cited in n. 2, p. 72; Howell Com. Rpt., p. 127.

24. E. Kotcher, Tech. Staff, MD, ESMR #50-461-351, 18 Aug. 1939; Misc. Data, cited in n. 19; memo for Pres., Rsch. Bd. from Arnold, 10 May 1939; *New York Times*, 10, 13, 18, 26 Jan., 15 June 1939; Twelfth Annual Report, C/MD, FY 1938, pp. 10–11.

25. Perazich and Field, *Industrial Research and Changing Technology* (Philadelphia, 1940), p. 68; AHS-50, Materiel Research and Development in the Army Air Arm, p. 49. This study, prepared by Martin P. Claussen, was a major source in the preparation of this section of the chapter.

26. Ltr., TAG to Chiefs of Arms and Services, 15 Sept. 1939. The report of the Air Board was attached.

27. Final Rpt. of Air Corps Board on Revision to the 5-Year Experimental Program, 28 June 1939.

28. Ltr., TAG to C/AC, 10 Aug. 1939; Supplement to Final Rpt. of Air Corps Board on Revision to the 5-Year Experimental Program, 28 Sept. 1939; Annual Rpt. of the C/AC, FY 1939, pp. 63–64.

29. Hist., Mat. Comd., 1926–41, pp. 1, 101–2; MD Org. Chart, 15 Aug. 1939.

30. Hist., Mat. Comd., 1926–1941, pp. 6a, 10; AHS-50, pp. 41–48.

31. *Aviation Facts and Figures 1945*, p. 145. For FY 1940 the Navy received $9.5 million for aeronautical research and development, compared with $10 million for the Air Corps.

32. Annual Rpt. of C/MD, FY 1939, p. 25.

33. AHS-50, pp. 62–63.

34. *Ibid.*, pp. 64–67; President's Military Order, 1 July 1939.

35. AHS-50, pp. 82–87.

36. *Ibid.* For a detailed discussion, see pp. 68–82.

37. *Ibid.*

38. AHS-22, Legislation Relating to the AAF Materiel Program, 1939–1944, pp. 80–101; Annual Rpt. of C/AC, FY 1939, pp. 71–72; ltr., Brig. Gen. Geo. H. Brett, C/MD to C/AC, 21 Mar. 1939.

39. Harry Yoshpe, Study of Experience in Industrial Mobilization in World War II, Plans for Industrial Mobilization 1920–1939, Army Industrial College RP No. 28, Nov. 1945, pp. 10–16.

40. Industrial Mobilization Planning Div., AMC, Pre-World War II Industrial Preparedness, 10 Mar. 1948, pp. 19–21, 35–43; Tom Lilley *et al.*, *Problems of Accelerating Aircraft Production During World War II* (Cambridge, Mass., 1946), p. 24.

41. Lilley, *Problems*, pp. 31–38; memo for Spaatz, C/Plans Div. from Maj. Myron R. Wood, 14 Aug. 1939; *Aviation Facts and Figures 1945*, p. 8; memo for C/AC from Gen. Brett, 4 May 1939, p. 2; memo for Exec. OCAC from Wood, 8 Aug. 1939.

42. Pre-World War II, cited in n. 40, pp. 59, 67–70; memo for Exec. OCAC from Maj. Myron R. Wood, 8 Aug. 1939.

43. Ltr., Arnold to Boeing A/C Co. (and other manufacturers), 16 Aug. 1938.

44. OCAC, Min. Quantity Production Conf., 6 Sept. 1938.

45. OCAC, Résumé of Div. Chiefs Sp. Mtg.—24 April 1939; ltr., Arnold to Robert E. Gross, Pres., Lockheed A/C Corp., 30 June 1939.

46. OCAC, Proceedings of Procurement Conf., Washington, 10 July 1939, pp. 1–2.

47. *Ibid., passim.*

48. Memo for C/AC from Brett, C/MD, 14 Sept. 1939; Bd. Proceedings, Wright Fld., 15 Sept. 1939.

49. Proceedings, cited in n. 46, *passim.*

50. Memo for AS/W from Arnold, 26 July 1939.

51. Memo for AS/W from Arnold, 21 Aug. 1939; memo for Col. H. K. Rutherford OAS/W from Lt. Col. E. E. MacMorland, OAS/W, 23 Aug. 1939.

52. Memo for C/AC from Col. J. H. Burns, Exec. OAS/W, 15 July 1937; memo for AS/W from Maj. Gen. Oscar Westover, C/AC, 6 Aug. 1937; memo for C/S from Actg. S/W, 15 Nov. 1938.

53. *A Chronicle of the Aviation Industry in America, 1903–1947* (Cleveland, 1948), p. 20.

54. *Aviation Facts and Figures 1945*, p. 8; *Aircraft Year Book, 1919–31; Wall Street Journal*, 31 Jan. 1939, p. 13; *Fortune*, 1 Dec. 1939, p. 72.

55. Lilley, *Problems*, p. 14; *Wall Street Journal*, 3 Jan. 1939, p. 23.

56. *Report of the Chief of Staff, U.S. Army*, 1935 (Washington, 1935), p. 13; Fed. Works Agency, *Millions For Defense: Emergency Expenditures for National Defense 1933–1940* (Washington, 1940).

57. Lilley, *Problems*, p. 14; George B. Woods, *The Aircraft Manufacturing Industry, Present and Future Prospects* (New York, 1946), Introduction, p. 2.

58. Hq. ATSC, Special Planning Project C-1, Progress Rpt., Financial and Economic Analysis of the Postwar A/C Industry, 29 Sept. 1945 [hereinafter cited Sp. Planning Proj.]; Woods, *The Aircraft Manufacturing Industry*, Introduction, pp. 2, 7, 37; Lilley, *Problems*, p. 5; *Aviation Annual of 1946*, p. 90; *Aviation Facts and Figures 1945*, p. 6; *Wall Street Journal*, 3 Jan. 1939, p. 23.

59. Sp. Planning Proj., *Aeronautical Engineering Review*, Nov. 1942, p. 51; Lilley, *Problems*, p. 58; *Fortune*, Dec. 1939, p. 73; Phone conversation between Col. H. W. Harms and Maj. J. P. Richter, MD, 27 Jan. 1939; *Wall Street Journal*, 11 Apr. 1939, p. 2; 4 Apr. 1939, p. 3; 31 Mar. 1939, p. 17; 28 Mar. 1939, p. 3; 8 Apr. 1939, p. 3; 15 Feb. 1940, p. 15.

60. Lilley, *Problems*, p. 58; *Aeronautical Engineering Review*, Nov. 1942, p. 51; ltr., Gen. Brett, C/MD to C/AC, app. II, pp. 2–3, 7 July 1939; *Wall Street Journal*, 24 Mar. 1939, p. 9.

61. Sp. Planning Proj.; memo for Col. Spaatz, Plans Div., OCAC from Maj. Myron R. Wood, 14 Aug. 1939.

62. Woods, *The Aircraft Manufacturing Industry*, p. 15; *Aviation Facts and Figures 1945*, p. 8; *Wall Street Journal*, 13 Nov. 1939, p. 1; ltr., Gen. Brett to C/AC, 25 July 1939. For more detailed figures, see the *Aircraft Year Book* for the years mentioned.

63. Memo for AS/W from Arnold, 6 Sept. 1939.

64. Memo for Exec. OCAC from Maj. Myron R. Wood, 8 Aug. 1939; ltr., Gen. Brett to C/AC, 25 July 1939.

65. Memo for AS/W from Arnold, 6 Sept. 1939.

66. Notebook of Spaatz, min. of mtg., 16 Nov. 1939; ltr., Brett to C/AC, 25 July 1939.

67. Memo for AS/W from Arnold, 26 July 1939; Conf. Internal Memo from Capt. D. C. Ramsay, BuAer, Aer-PL-4-EMN L8(1), 9 Sept. 1939; memo for BuOrd from BuAer (sgd. Capt. M. Mitscher), Aer-PL-4-EMN, L8(1), L-1-(41), 20 July 1939; *Wall Street Journal,* 19 Jan. 1940, p. 15.

68. Ltr., C/AC to TAG, 30 Mar. 1939; *Wall Street Journal,* 13 Nov. 1939, p. 1; 10 July 1939, p. 3; 10 Oct. 1939, p. 2; 31 Jan. 1939, p. 13; 18 Oct. 1939, p. 1; 7 Dec. 1939, p. 2; *Aero Digest,* May 1940, p. 45; *Fortune,* Mar. 1940, p. 69.

69. Ltr., C/AC to TAG, 30 Mar. 1939; *Wall Street Journal,* 23 Aug. 1939, p. 2; 21 Sept., p. 1; ltr., Gen. Brett to C/AC, 25 July 1939.

70. *Wall Street Journal,* 10 June 1939, p. 1; 2 Jan. 1940, pp. 1, 20; memo for Gen. Brett from Lt. Col. W. F. Volandt, C/Contracts Sec., MD, 11 Sept. 1939.

71. *Wall Street Journal,* 10 June 1939, p. 1; Proceedings, cited in n. 46, pp. 25–26.

72. Memo for the Pres. from Louis Johnson, AS/W, 8 Aug. 1939, with notation "O.K. F.D.R."; memo for AS/W from Arnold, 7 Aug. 1939.

NOTES TO CHAPTER 6

1. Armament Conf., Washington, 27 Dec. 1939, pp. 1–3; memo for C/S from Col. E. W. McCabe, AC/S G-2, 29 Jan. 1940; Pursuit Bd. Rpt., The Future Development of Pursuit Aircraft, 27 Oct. 1941.

2. ATSC Engr. Div., Army Aircraft Engine Model Designations, 1 May 1945, pp. 31–33 [hereinafter cited Engine Designations]; Tom Lilley *et al., Problems of Accelerating Aircraft Production During World War II* (Cambridge, Mass., 1946), p. 19.

3. C/Engr. Div., ATSC, Rpt. No. TSEST-A7, Army Model Designations, 1 June 1946, pp. 59–70 [hereinafter cited TSEST-A7].

4. Robert Schlaifer and S. D. Heron, *Development of Aircraft Engines and Fuel* (Boston, 1950), pp. 250–56, 262–95.

5. ATSC, Tactical Planning Characteristics and Performance Chart, Aug. 1945 [hereinafter cited Tactical Planning Chart]; Arnold to C/MD, 27 Jan. 1938; Schlaifer and Heron, pp. 501–7, 626–30, 672–75; MD, Preliminary Characteristics and Performance Chart, 1 July 1939; MD, Airplane Characteristics and Performance Chart, 30 June 1941; Tactical Planning Chart, pp. 13, 35, 36.

6. TSEST-A7; AAF Statistical Digest, World War II, p. 135 [hereinafter cited AAF Stat. Digest]; Hq. AAF, SC-SS-944, Delivered Airplanes on Hand in the AAF by Type, Model, Series, and Location, 31 Mar. 1945.

7. 1st ind. (ltr. C/AC to AG, 31 Aug. 1938), AG to C/AC, 5 Oct. 1938.

8. Memo from C/AC from Lt. Col. Spaatz, D/Plans Div., OCAC, 11 Apr. 1939.

9. Edward O. Partee, The Development of Light and Medium Bombers, 1946, p. 35 [hereinafter cited Light and Medium Bombers]; AAF Stat. Digest, pp. 118–19; memo for CG ASC from Col. J. H. Hicks, C/Air Force Sec., 27 May 1942.

10. AAF Stat. Digest, pp. 118, 138; Light and Medium Bombers, p. 39; D/Rsch. and Rpts., Stat. Dept., Report on War Aid Furnished by the United States to the USSR, 28 Nov. 1945 [hereinafter cited War Aid to USSR].

11. Memo for the C/AS from Brig. Gen. Donald W. Wilson, AC/AS OC&R, 26 Nov. 1944; AAF Stat. Digest, p. 123.

12. TSEST-A7, p. 3; Hq. ATSC, Model Designation Army Aircraft, 11th ed., Jan. 1945, pp. 4–6; Engine Designations, pp. 36–37; Stat. Control Off., Wright Fld., WS-278, Airframe Unit Weight, Dec. 1943 [hereinafter cited Airframe Unit Weight]; MD, Airplane Characteristics and Performance Chart, 30 June 1941 [hereinafter cited Airplane Characteristics]; Tactical Planning Chart, p. 21.

13. Hist. Off., Mat. Comd., Case History of A-24 Airplane Project; R&R, Gen. Brett, C/MD to C/AC, 8 June 1940; min., Hq. AAF staff mtg., 19 Dec. 1941; conf., Gen. [Ralph] Royce in General Fairchild's office with representatives from D/MR, Air Staff, etc., 29 Aug. 1942. See also, Vol. IV, this series.

14. Light and Medium Bombers, p. 49; AAF Stat. Digest, pp. 121–22; TSEST-A7,

p. 6; Maj. Thomas Hitchcock, Asst. Mil. Att., London, memo: History of the Mustang P-51 Aircraft, 8 Oct. 1942, p. 1; memo for CG Mat. Comd. from Col. T. J. Hanley, Jr., AC/AS A-4, 16 Apr. 1942; Col. M. E. Gross, memo for rcd., Airplane Procurement and Conversion, 6 May 1942.

15. *AAF in WW II*, II, 569; AAF Stat. Digest, p. 139.

16. TSEST-A7, pp. 12–13.

17. *Ibid.*, pp. 13–14; Louis H. Sibilsky, MD, Memorandum Report on Medium Bomber (B-26) Airplane, A.C. No. 40-1361, 28 Jan. 1941.

18. TSEST-A7, pp. 12–14; AAF Stat. Digest, pp. 120–24; Opns. Stat. Div., D/SS, Selected Combat Units Overseas—By Type of Aircraft, 14 May 1952 [hereinafter cited Selected Units Overseas].

19. AAF Stat. Digest, pp. 118, 138–39; DAR, AC/AS M&S, 1–2 Apr. 1945; War Aid to USSR.

20. TSEST-A7, pp. 12–14; Tactical Planning Chart, pp. 17–19; Engine Designations, pp. 36–41; Airframe Unit Weight; Airplane Characteristics and Performance Chart.

21. Tactical Planning Chart, pp. 17–19; Selected Data on Aircraft, pp. 13–14.

22. Col. G. E. Stratemeyer, Diary for C/AC, 9 July 1941; min., 15 July [1941] mtg. of the Air Council, 16 July 1941; Hist. Off., Mat. Comd., Case History of B-26 Airplane Project.

23. Ltr., Brig. Gen. M. S. Fairchild, D/MR to Maj. Gen. Carl Spaatz, Pres., Bd. of Off., 31 Mar. 1942; Proceedings of Bd. of Off. Appointed by Par. 15, SO 28, Hq. AAF, 31 Mar. 1942, Gen. Spaatz, 2–5 Apr. 1942; Stat. Sec., Mat. Comd., Statistical Data on Progress of Procurement of Materiel, 30 Apr. 1942, Tab "E," Part I, p. 2.

24. TSEST-A7, p. 14; memo for CG Mat. Comd. from Col. M. E. Gross, D/MR, 8 July 1942; memo for Gen. Echols, CG Mat. Comd. from Gen. Fairchild, D/MR, Hq. AAF, 7 Oct. 1942.

25. R&R, C/AS to CG Mat. Comd., 10 Oct. 1942.

26. Memo for AC/AS Plans from Col. Randolph P. Williams, 26 June 1943, pp. 2–3; Selected Units Overseas; R&R, Gen. Giles to Gen. Arnold, 29 June 1943; *AAF in WW II*, II, 339–41, III, 121; R&R, Arnold to Giles, 22 June 1943.

27. Ltr., Donald Douglas, Douglas Aircraft Co., to Gen. Arnold, 1 June 1941; TSEST-A7, pp. 4–5; min., D/MR staff mtg., Hq. AAF, 20 Mar. 1942; Teletype EXP-T-136, Col. F. O. Carroll to CG Mat. Comd., 11 July 1942; AAF Stat. Digest, pp. 118, 122; Selected Units Overseas.

28. TSEST-A7, pp. 4–5; Tactical Planning Chart, p. 23; Selected Data on Aircraft, p. 16.

29. Memo for Col. Stearley from Col. W. E. Karnes, D/Air Spt., Hq. AAF, 9 Feb. 1943; min., Aircraft Production Bd. mtg., 13 Dec. 1943; R&R, Arnold to Echols, 13 Mar. 1944; AAF Stat. Digest, pp. 122–23; R&R, Gen. Echols, CG Mat. Comd. to Gen. Giles, AC/AS OC&R, 16 Mar. 1944; memo for C/AS from Brig. Gen. D. Wilson, AC/AS OC&R, 26 Nov. 1944; ltr., Lt. Gen. Ira C. Eaker, C/AS to Lt. Gen. John K. Cannon, CG MAAF, 22 May 1945; AAF Stat. Digest, pp. 122–24.

30. Air Service Engr. Div., Annual Rpt. (1922), p. 6; James C. Fahey, *U.S. Army Aircraft, 1908–1946* (New York, 1946), p. 15; H. H. Arnold, *Global Mission* (New York, 1949), p. 110.

31. WD Press Release, 16 Oct. 1937; memo for C/AC from C/MD, 8 Apr. 1938; memo for C/AC from AS/W, 9 June 1938.

32. AHS-6, The Development of the Heavy Bomber, 1918–1944, pp. 86–88.

33. Memo for AG from C/AC, 8 Nov. 1935; Fahey, p. 22; memo for C/Plans Div. from Brig. Gen. O. Westover, Actg. C/AC, 31 Oct. 1935; 1st ind. (memo for AG from AC/AC, 8 Nov. 1935), AG to C/AC, 21 Nov. 1935; memo for Arnold from Brig. Gen. L. W. Miller, Bud. and Fisc. Off., Hq. AAF, 15 Apr. 1943 (this was a study of the "Development of 4-Engine Bombers, 1933–1939" and was essentially a brief of the pertinent documents); FSS, MD, Operations Report of Airplanes as of 31 July 1937, 8 Aug. 1937.

34. Memo for C/S from Brig. Gen. G. R. Spalding, AC/S G-4, 25 June 1936.

35. WD Sp. Quarterly Rpt. of Airplanes, 31 Dec. 1938.

36. Ltr., CG GHQ AF to AG, 1 June 1937.

37. WD Sp. Quarterly Rpt. of Airplanes, 30 June, 30 Sept. 1939.

38. AAF Stat. Digest, p. 118.

39. *Ibid.*, pp. 135, 140, 150.
40. 1st ind. (ltr., C/AC to AG, 31 Aug. 1938), AG to C/AC, 5 Oct. 1938.
41. Ltr., Actg. C/AC to AS/W, 13 May 1938 and 2d ind. thereto, AG to AS/W, 6 Aug. 1938.
42. Airframe Unit Weight; Airplane Characteristics; MD, OCAC, Characteristics and Performance of U.S. Army Airplanes Chart, 1 July 1939.
43. Arnold to C/MD, 27 Jan. 1938; lecture by Brig. Gen. Franklin O. Carroll, 5 July 1943, p. 10; TSEST-A7, p. 9; Tactical Planning Chart, p. 7.
44. Chart, Characteristics, as cited in n. 42; Airplane Characteristics; Tactical Planning Chart, pp. 6–7; TSEST-A7, pp. 9–10.
45. TSEST-A7, pp. 9–10; Airframe Unit Weight.
46. See Monthly Stat. Sum. 8th AF Opns., Apr. 1944–Apr. 1945.
47. AAF Stat. Digest, pp. 118, 136–39.
48. *Ibid.*, pp. 156–79; Selected Units Overseas.
49. Memo for C/MD from C/AC, 19 Jan. 1939; 1st ind. (memo for AS/W from C/AC, Mar. 1939), AS/W to C/AC, 8 Apr. 1939.
50. AHS-6, p. 80; Prod. Engr. Sec., MD, OCAC, Current Production Airplane Contracts, Week Ending 16 Sept. 1939.
51. Airplane Characteristics; Airframe Unit Weight; lecture by Col. C. Spaatz, 31 July 1939; ltr., Lt. Gen. J. H. Doolittle, CG 8th AF to Lt. Gen. B. M. Giles, C/AS, 25 Jan. 1945; IOM, Maj. K. B. Wolfe to Tech. Exec. MD, 30 Oct. 1940; TSEST-A7, pp. 11–12; Airframe Unit Weight; Tactical Planning Chart, pp. 8–9.
52. Memo and incl., Brig. Gen. M. E. Gross to Brig. Gen. D. W. Wilson, AC/AS OC&R, 20 Nov. 1944; R&R, Gen. Giles to Gen. Echols, 5 Sept. 1944.
53. Airplane Characteristics; Tactical Planning Chart, p. 9; Selected Data on Aircraft, pp. 11–12.
54. Ltr., Doolittle to Giles, 25 Jan. 1945. See also memo for C/AS from Gen. H. A. Craig, 22 May 1944.
55. Selected Data on Aircraft, pp. 11–12; memo for C/AS from Brig. Gen. H. A. Craig, 22 May 1944.
56. Memo for AG from Brig. Gen. W. G. Kilner, Actg. C/AC, 27 Jan. 1939; ltr., C/AC to AS/W, 10 Nov. 1939; ltr., C/MD to C/AC, 3 June 1940, and 1st ind. thereto, C/AC to AS/W, 22 June 1940; AAF Mat. Comd., Research and Development Projects of the Engineering Division (4th ed., 1 Jan. 1944), pp. 31–34; AHS-6, p. 89.
57. AHS-112, History of the Twentieth Air Force: Genesis, pp. 10, 26 ff.; AAF Stat. Digest, pp. 7, 122–24, 139, 179; Selected Units Overseas; TSEST-A7, p. 15.
58. Memo for DC/AS from Gen. Echols, 30 Sept. 1942; ltr., Col. J. F. Whiteley, AI to CG AAF, 27 Aug. 1942, pp. 1–2.
59. Airframe Unit Weight.
60. Ltrs., Gen. Echols, C/MD to Asst. C/MD, 20 Sept., 27 Oct. 1941; ltr., Col. J. F. Whiteley, AI to CG AAF, 27 Aug. 1942, pp. 1–2; AAF Stat. Digest, p. 116; interview with Gen. K. B. Wolfe by A. Goldberg, 6 June 1952.
61. TSEST-A7, p. 15; Tactical Planning Chart, pp. 12–13.
62. Tactical Planning Chart, pp. 12–13.
63. MD, OCAC, Wkly. Rpt., 21 Aug. 1940; memo for Gen. Wilson from Brig. Gen. M. E. Gross, 6 Dec. 1944.
64. TSEST-A7, pp. 15–16; ltr., H. A. Sutton, Consolidated Aircraft Corp. to Col. Carl F. Greene, Mat. Comd. Ln. Off. at NACA Laboratory, Langley Fld., 24 Oct. 1942; Engr. Div., Mat. Comd., Research and Development Projects, 1 Jan. 1944.
65. Memo for Gen. Arnold from Gen. H. A. Craig, 11 Jan. 1944; memo for DC/AS from Col. Gross, 2 Mar. 1943.
66. Ltr., Gen. H. A. Craig to Gen. Arnold, 2 Sept. 1944; AAF Stat. Digest, pp. 118, 153, 172; DAR, AC/AS M&S, 15–16 Apr. 1945.
67. Ltr., Sutton to Greene, as cited in no. 64.
68. Ltr., Gen. H. A. Craig to Gen. Arnold, 2 Sept. 1944.
69. Memo for Gen. Wilson from Gen. Gross, 6 Dec. 1944.
70. R&R, Gen. Timberlake to AC/AS, M&S, 6 Feb. 1945.
71. Memo for C/AS from Brig. Gen. E. M. Powers, Actg. AC/AS M&S, 19 May 1945; memo for Maj. Gen. R. L. Walsh from Brig. Gen. W. E. Todd, AC/AS Plans, 12 July 1945; DAR, Prod. Div., AC/AS M&S, 16 Oct. 1945.
72. 1st ind. (ltr., OCAC to Hq. GHQ

AF, 14 Nov. 1939), Hq. GHQ AF to C/AC, 11 Jan. 1940. See Vol. I, 64–65, this series, for a statement by Westover in 1933 which supports this statement.

73. See n. 72.

74. TSEST-A7, pp. 61–63; AAF Stat. Digest, p. 119.

75. Doris Canham, Hist. Off., AMC, Development and Production of Fighter Aircraft for the United States Air Force (Oct. 1949), pp. 58, 68, 72.

76. R&R, Col. J. W. Sessums, MC, to D/Air Def., Att: Col. Saville, Hq., AAF, 15 Oct. 1942, quoting from a letter of Kenney's.

77. Airframe Unit Weight; TSEST-A7, pp. 59, 61–64; Tactical Planning Chart, pp. 33–34.

78. See sources cited in n. 77; Airplane Characteristics; Agenda for Initial Mtg. of JAAC, 27 May 1940.

79. Tactical Planning Chart, pp. 33–34; Engine Designations, pp. 23–27; TSEST-A7, pp. 61–64; Airplane Characteristics; Pursuit Bd. Rpt., The Future Development of Pursuit Aircraft, 27 Oct. 1941; memo for AS/WA from Gen. Echols, 27 Oct. 1942; ltr., Brig. Gen. C. W. Russell, C/S AFCC to C/AAF, 25 Aug. 1941; memo for D/MR from Col. G. P. Saville, D/Air Defense, 6 July 1942.

80. Telephone conversation between Maj. Richter, MD and Maj. D. G. Lingle, OCAC, 28 Jan. 1939; TSEST-A7, p. 60; memo for Exec. MD from Capt. P. W. Timberlake, 5 Mar. 1940; memo for the Administration of Priorities from Robert P. Patterson, US/W, 9 Jan. 1941; AAF Stat. Digest, p. 120.

81. Airplane Characteristics; Tactical Planning Chart, p. 32; Selected Data on Aircraft, p. 17.

82. Airframe Unit Weight; Airplane Characteristics; Tactical Planning Chart, p. 32; Schlaifer and Heron, p. 310.

83. AAF Stat. Digest, pp. 118–24, 136–39; Selected Units Overseas.

84. See sources cited in n. 83.

85. TSEST-A7, p. 60; General Summary of Items Presented to and Considered by the Emmons Board, May 1940; draft, Experimental Engr. Sec., MD, memo rpt., 2 May 1940.

86. TSEST-A7, pp. 65–66; AAF Stat. Digest, p. 120; IOM, B. E. M[eyers] to Gen. Echols, C/MD, 13 Dec. 1941; ltr., Maj. Gen. W. R. Weaver, Actg. C/AC to C/AAF, 15 Dec. 1941.

87. Ltr., Arnold to AM A. T. Harris, 18 Sept. 1941.

88. Tactical Planning Chart, p. 35; AC/AS M&S, Consolidated List of New Developments, 15 July 1945; memo for Gen. Echols from R. A. Lovett, AS/WA, 3 July 1944; memo for Brig. Gen. W. F. McKee, OC&R from Col. L. O. Peterson, C/Reg. Div., 26 May 1945; Airplane Characteristics; ltr., Gen. W. R. Weaver, Actg. C/AC to C/AAF, 15 Dec. 1941; TSEST-A7, p. 60; Engine Designations, pp. 38–41; Airframe Unit Weight.

89. Airplane Characteristics; Tactical Planning Chart, p. 35; Consolidated List, as cited in n. 88.

90. Project Program for Study on Pursuit and Fighter Aircraft, prepared at Maxwell Fld., 4 Mar. 1940. See also R&R for Exec. OCAC from C/Plans Div., 16 Apr. 1940; ltr., E. V. Rickenbacker to S/W, 12 Oct. 1942; Daily Diary, D/MR, 18 Sept. 1942; Hq. AAF A-2 interview with Col. L. C. Craigie, 12 Jan. 1943.

91. Ltr., Maj. B. W. Chidlaw, C/Exp. Engr. Br., MD to C/MD, 19 Aug. 1941.

92. Hq. ATSC, Case History of the Fighter Airplane Range Extension Program, Feb. 1945; memo for Robert A. Lovett, AS/WA from Brig. Gen. B. E. Meyers, Exec. Mat. Comd., 28 Mar. 1942; D/MR Daily Diary, 28 Nov. 1942; conf. of Wright Field Personnel and D/MR, Hq. AAF, 6 July 1942, p. 3.

93. Hitchcock memo cited in n. 14; Hq. AAF A-2 interview with Col. Cass Hough, 1 Apr. 1943; TSEST-A7, pp. 51–52; AAF Stat. Digest, pp. 120–21.

94. Hitchcock memo cited in n. 14.

95. Ltr., E. V. Rickenbacker to Henry L. Stimson, S/W, 12 Oct. 1942, pp. 9, 12.

96. Memo for the President from Arnold, 12 Nov. 1942.

97. See AAF Stat. Digest, pp. 121–22.

98. *Ibid.*, pp. 118–24, 136–39.

99. Arnold, *Global Mission*, p. 376.

100. Tactical Planning Chart, p. 36; TSEST-A7, pp. 67–70; Selected Data on Aircraft, pp. 20–21; Consolidated List, as cited in n. 88.

101. TSEST-A7, pp. 74–75; Development and Production of Fighter Aircraft, cited in n. 75, pp. 77–79; AAF Stat. Digest, p. 122.

102. Consolidated List, as cited in n. 88.

103. TSEST-A7, pp. 74–75; Tactical Planning Chart, p. 37; Development and Production of Fighter Aircraft, pp. 78–79.

104. Mary Self, AMC, Reconnaissance Aircraft and Aerial Photographic Equipment, 1915–1945, June 1946 [hereinafter cited Reconnaissance Aircraft].

105. R&R, DC/AS to AC/AS MM&D, 26 May 1943; Comment #2, R&R, AC/AS MM&D to AC/AS OC&R, 3 June 1943; memo for CG AAF from Lt. Gen. J. T. McNarney, DC/S, 30 June 1943; Comment #2, R&R, Gen. Echols to Maj. Gen. G. E. Stratemeyer, C/AS, 12 July 1943; ltr., Contract W 33-038 AC-1079, 11 Oct. 1943; inter-desk memo, Brig. Gen. B. Chidlaw to Gen. Echols, AC/AS MM&D, 26 Nov. 1943.

106. DAR, AC/AS MM&D, MD, 1 Sept. 1943; rcd. of conf. held in Gen. Meyers' office, 8 Oct. 1943; Arnold, *Global Mission*, pp. 377–78.

107. Reconnaissance Aircraft, pp. 184–87.

108. *Ibid.*, pp. 135–71; AAF Stat. Digest, pp. 118–24, 135–39, 153; TSEST-A7, pp. 39–40.

109. AHS-44, Evolution of the Liaison-Type Airplane, 1917–1944. Except where otherwise noted, the ensuing discussion of liaison aircraft is based on this study.

110. Ltr., Brig. Gen. J. F. Phillips, C/MD, AC/AS M&S to D/ATSC, 15 May 1945; AAF Stat. Digest, pp. 118–24, 135; memo for C/AC from Brig. Gen. B. K. Yount, 9 Oct. 1940.

111. Hist. Div., ATSC, Development of Transport Airplanes and Air Transport Equipment, Apr. 1946. Unless otherwise noted, information on transport aircraft is drawn from this study.

112. TSEST-A7, pp. 26–28; AAF Stat. Digest, pp. 118–24.

113. Tactical Planning Chart, pp. 24–27; AAF Stat. Digest, pp. 118–24; Stat. Data on Progress, as cited in n. 23, Tab "E," Part I, pp. 6–7; ltr., Brig. Gen. J. L. Loutzenheiser, Actg. AC/AS Plans to Pres., AAF Bd., 27 Apr. 1945; memo for Maj. Gen. H. A. Craig, AC/AS OC&R from Brig. Gen. M. E. Gross, C/Req. Div., OC&R, n.d., but 1944.

114. R&R, AC/S A-4 to Gen. Arnold, 16 Nov. 1942; AAF Stat. Digest, p. 118.

115. R&R, Gen. Fairchild, D/MR to AC/S A-3, Hq. AAF, 12 Nov. 1942; R&R, AC/S A-4 to Gen. Arnold, 16 Nov. 1942; TSEST-A7, pp. 34, 37.

116. TSEST-A7, pp. 26–30; AAF Stat. Digest, pp. 118–24; memo for Gen. Craig, cited in n. 113.

117. Raymond J. Snodgrass, Hist. Off., AMC, the AAF Glider Program, November 1944–January 1947, Nov. 1947.

118. AAF Stat. Digest, p. 118.

119. *Ibid.*, pp. 135–39.

120. Edward O. Partee, Hist. Sec., T-2, AMC, The Modification and Development of Training Aircraft for AAF Use, Nov. 1946.

NOTES TO CHAPTER 7

1. Ltr., Lt. Gen. Ira C. Eaker to Gen. G. C. Kenney, 6 Sept. 1945.

2. R&R, Plans Div. to Gen. Arnold, 31 Jan. 1940.

3. Memo for S/W and C/S from F.D.R., 24 May 1940.

4. Memo rpt., Maj. L. C. Craigie, MD, 18 June 1940; memo for Exec. OCAC from Gen. Arnold, 14 June 1940.

5. Memo by Craigie cited in n. 4.

6. Tech. Instr. to Tech. Exec., Wright Fld., from Maj. A. J. Lyon, 16 Sept. 1940.

7. Memo rpt., Experimental Engr. Sec., ser. #EXP-M-50-476, 17 Oct. 1940.

8. Memo by Robert A. Lovett, 30 Dec. 1940.

9. H. H. Arnold, *Global Mission* (New York, 1949), pp. 242–43.

10. Ltr., Col. W. F. Volandt, Asst. to C/MD to Wright Aeronautical Corp., Paterson, N.J., 8 May 1941.

11. R&R's, Brig. Gen. Edwin S. Perrin, DC/AS to AC/AS Plans and AC/AS OC&R, 12 Feb. 1944; Brig. Gen. L. S. Kuter, AC/AS Plans to AC/AS OC&R, 17 Feb. 1944; Col. Jack Roberts, AC/AS OC&R to AC/AS M&S, 3 Feb. 1945; memo for D/Sp. Planning Div. (thru DC/S) from Brig. Gen. W. A. Borden, D/New Developments Div., 9 Mar. 1945; ltr., Brig. Gen. J. F. Phillips, AC/AS M&S to D/AAF ATSC, Mar. 1945; memo for DC/S from Maj. Gen. J. E. Hull, AC/S OPD, 18 Apr. 1945.

12. Hist. AAF Mat. Comd., 1926–1941, *passim.* See also, histories for 1942 and 1943, and AHS-10, Organization of

the Army Air Arm, 1935–1945, pp. 57–59, 78.

13. Hist. AAF Mat. Comd., 1943, pp. 5–6, 10, 13; Report of Study of Duplication of Army Air Forces and Naval Air Forces, prepared for AS/WA, 29 Jan. 1944 [hereinafter cited Rpt. of Duplication].

14. Hist. AAF Proving Ground Comd., Part 1, III–IX.

15. AHS-13, The Development of Tactical Doctrines at AAFSAT and AAFTAC, p. 1 ff.; Rpt. of Duplication.

16. Memo for C/S from Gen. Arnold, 1 Mar. 1940.

17. Memo for C/AC from S/GS (by direction of C/S), 28 Mar. 1941; memo for AC/S WPD from AC/AS G-4, 14 Oct. 1941. An excellent discussion of relations between the Air Corps and General Staff during this period is found in Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations* (Washington, 1950), pp. 285–98.

18. Memo for Arnold and Somervell from Marshall, 26 July 1944; ltr., Lt. Gen. J. T. McNarney, DC/S to CG AAF and CG ASF, 26 Aug. 1944; ltr., TAG to CG AAF and CG ASF, 21 Oct. 1944; AAF HOI #20-75, Dec. 1944.

19. WD Cir. 333, 15 Aug. 1943; AHS-50, Materiel Research and Development in the Army Air Arm, 1914–1945, p. 149.

20. Ltr., Gen. Brett to C/AC, 21 Mar. 1939; Orgn. and Functional Hist. A-3 in AAF Hq., 1939–1945, p. 27.

21. OCAC Cir. 65-39, pp. 2–4; Hist. A-3 cited in n. 20, pp. 22–24.

22. Min., initial mtg. of Air Council, 2 July 1941.

23. Min., Hq. AAF staff mtg., 19 Dec. 1941.

24. Conf. of Wright Fld. Pers., Mat. Comd. and D/MR, 6 July 1942.

25. Min., D/MR staff mtg., 3 July 1942; conf. cited in n. 24.

26. Memo for D/MR from Maj. Gen. G. E. Stratemeyer, C/AS, July 1942; Tab A to min., 1st mtg. AF Mat. Planning Council.

27. Memo for AC/AS OC&R and AC/AS M&S from Brig. Gen. P. W. Timberlake, DC/AS, 20 Dec. 1944; interview with Brig. Gen. Alfred R. Maxwell, RDB, by Alfred Goldberg, 18 Sept. 1952; R&R, Gen. Chidlaw to Req. Div., OC&R, 7 Apr. 1943.

28. Notes on Conf. Resulting from R&R dated 9 Mar. to AC/AS M&S, sub.: Post War Procurement Policies, 12 Mar. 1945; DAR, MD, MM&D, 5 Apr. 1944; Inter-desk memo, Col. R. C. Wilson, C/Devel. Engr. Br. to MD, 15 May 1944; interview cited in n. 27; ltr., Gen. Carroll to CG AAF, attn.: AC/AS MM&D, 8 May 1944; ltr., Col. R. C. Wilson to D/ATSC, 21 Oct. 1944; min., M&S staff mtg., 27 Apr. 1945.

29. AHS-50, pp. 113–14.

30. Memo for Dr. Bowles, Gen. Echols, *et al.* from Maj. Gen. H. A. Craig, AC/AS OC&R, 23 June 1944; memo for Gen. Arnold from Col. J. F. Griffin, 15 Aug. 1944.

31. R&R, Gen. Arnold to Gen. Eaker, 22 May 1945; ltr., Gen. Eaker to Gen. Kenney, 6 Sept. 1945; AAF HOI #20-(Draft), Nov. 1944; min., staff mtg., Air Comm. Off., 19 Feb. 1945; Theodore Von Karman, Where We Stand, a rpt. prepared for the AAF Scientific Advisory Bd., Aug. 1945.

32. Rpt. of Duplication; Capt. Lewis L. Strauss and Col. W. H. Draper, Jr., Coordination of Procurement Between the War and Navy Departments, Feb. 1945, I, 24–25 [hereinafter cited Strauss-Draper Rpt.]; memo for Gen. Robinson from Brig. Gen. A. R. Crawford, AC/S-4, 5 Dec. 1945.

33. Strauss-Draper Rpt., I, 25; Rpt. of Duplication; memo for Gen. Robinson, cited in n. 32; DAR's, MM&D, 27 Apr., 2 Sept. 1944.

34. IOM, Brig. Gen. G. C. Kenney, Asst. C/MD to C/MD, 23 July 1941; DAR, MD, M&S, 8 Nov. 1944; Rpt. of Duplication.

35. Hist. AAF Mat. Comd., 1942, pp. 116–17.

36. John R. Steelman, *Science and Public Policy, A Report to the President*, 4 Oct. 1947, II, 152 [hereinafter cited Steelman Rpt.].

37. *Ibid.*, p. 195.

38. James P. Baxter, *Scientists Against Time* (Boston, 1947), pp. 11–15 and app. A, p. 451.

39. Exec. Order #8807, 28 June 1941 (as amended by Exec. Order #9389, 18 Oct.

1943), in Baxter, app. B, pp. 452–55. See also Baxter, p. 124.

40. Baxter, *passim;* Rpt. of Duplication.

41. Baxter, p. 16.

42. Memo for Tech. Exec. MD from Maj. F. O. Carroll, 2 Nov. 1940; memo for Tech. Exec. MD from Maj. E. M. Powers, 25 Nov. 1940.

43. AHS-50, pp. 141–42.

44. DAR, MD, M&S, 7, 12, 21 Sept. 1944; DAR, M&S, 19 Sept. 1944.

45. See lecture by Gen. Arnold before Army Industrial College, 23 Feb. 1940.

46. Baxter, pp. 119–20.

47. Ltr., Henry L. Stimson, S/W to S/State, 12 Sept. 1940; Baxter, pp. 119–20.

48. Ltr., Gen. Kenney to Dr. Vannevar Bush, 7 June 1945; Baxter, pp. 120–24.

49. A-2 Interview with Cols. L. C. Craigie, M. S. Roth, and J. F. Phillips, 12 Jan. 1943; OPD File 966, 210.684 ETO; Hist. USSTAF, Admin., I, 14–17; ETO Hist. Sec., The Special Observer Group Prior to the Activation of ETO, Oct. 1944, *passim.*

50. AHS-50, p. 163; memo for DC/S from S/W, 13 Sept. 1940.

51. AHS-50, pp. 163–69.

52. R&R, Echols, C/MD to Gen. Brett, 3 Mar. 1941; R&R, Arnold to Brett, 11 Mar. 1941; memo for AS/WA from Gen. Brett, 13 June 1941; DAR, M&S, 2 Jan. 1945; AHS-50, pp. 165–67.

53. DAR's, MD, M&S, 8 Apr. 1944, 5 Mar., 8 June 1945; AHS-50, pp. 169–71.

54. Except where otherwise indicated, the ensuing discussion of research and development expenditures is based on AHS-50, pp. 135–54.

55. Steelman Rpt., III, 1.

56. Rudolf Modley, ed., *Aviation Facts and Figures 1945*, p. 145.

57. AHS-50, pp. 120–26.

58. Memo for Maj. Gen. Delos C. Emmons, CG GHQ AF from Gen. Arnold, 23 Apr. 1940; memo for Pres., AC Bd. on Rev. of the Five-Year Experimental Prog. from Col. Carl Spaatz, 22 Apr. 1940; draft memo, Experimental Engr. Sec., n.s., but probably Maj. A. J. Lyon, 2 May 1940; Capt. Howard G. Bunker, MD, memo rpt. on Kilner Bd. Progress, 27 May 1940.

59. Rpt. of action at initial mtgs., 2d mtg., 23 May 1940; memo for Brig. Gen. G. V. Strong, AC/AS WPD from Maj. Clayton Bissell, 6 May 1940.

60. Supplementary Rpt. to Rpt. of Bd. of Offs., 2 May 1940, 4th mtg. held 19–20 June 1940; ltr., Maj. A. J. Lyon, Tech. Exec. MD to Asst. C/MD, Wright Fld., 24 Apr. 1940.

61. R&R, Gen. Arnold to Brig. Gen. Barton K. Yount, AC/AC, Sept. 1940; memo for C/AC from Col. W. F. Volandt, Asst. C/MD, 5 Nov. 1940.

62. Ltr., Maj. B. W. Chidlaw, MD to Brig. Gen. Barton K. Yount, AC/AC, 20 Sept. 1940; memo for Maj. Lyon from Maj. E. M. Powers, 17 Oct. 1940.

63. See memo for Mr. Harvey H. Bundy, Sp. Asst. to S/W from Brig. Gen. M. S. Fairchild, AC/AC, 25 Nov. 1941.

64. *Ibid.;* Hist. AAF Mat. Comd., 1943, p. 13.

65. R&R, C/AS to CG AFCC and C/AC, 12 Jan. 1942; ltr., W. W. Dick, AAG (by order of Gen. Arnold) to Col. Earl L. Naiden, 21 Jan. 1942.

66. Hist. AAF Mat. Comd., 1942, pp. 118–19, and 1943, p. 13 ff.

67. R&R, Brig. Gen. B. W. Chidlaw, C/MD, MM&D to Lt. Col. Baldwin, 4 Jan. 1944.

68. See sources in n. 28.

69. Rpt. of Engr. Div., Mat. Comd. Special Planning Project B-7, Assignment Mc-14, 1 May 1944; Engr. Div., Wright Fld., Scope and Procedure Plans, Project B-7 Post-War Research and Development Program, Five Year Period FY 1946 to FY 1950 Inclusive, 28 Aug. 1944, pp. 11–12; memo for WDSS, New Development Div. from Gen. Phillips, 3 July 1945.

70. Memo for C/S from Gen. Arnold, 28 May 1945.

71. Memo for AWPD from Gen. Spaatz, AC/AC, 1 Jan. 1941.

72. Ltr., Lt. Col. A. E. Jones, C/Contract Sec., MD to Consolidated Aircraft Corp., San Diego, Calif., 11 Apr. 1941; IOM, Lt. Col. F. O. Carroll to C/Engr. Sec., MD, Washington, 11 Apr. 1941; ltr., David H. Fleet, Asst. to Manager, Consolidated Aircraft Corp. to Asst. C/MD, Wright Fld., 3 May 1941.

73. Min., Hq. staff mtg., 14 Aug. 1941; ltr., Maj. Chidlaw, C/Exp. Engr. Br., MD to C/MD, 19 Aug. 1941.

74. Ltr., Gen. Spaatz, C/AS to C/AC, 26 Aug. 1941; ltr., Lt. Col. F. O. Carroll to C/MD, 28 Aug. 1941.

75. Memo for Col. H. L. George,

C/AWPD from Maj. H. S. Hansell, 17 Sept. 1941.

76. Inter-desk memo, Lt. Col. Grandison Gardner, Engr. Sec., MD to Maj. H. S. Hansell, AWPD, 4 Oct. 1941; Carl Arnold, Exp. Engr. Sec., MD Memo Rpt. on Long-Range (Heavy) Bombardment Planes, Ser. #EXP-M-51B824, 3 Oct. 1941; WD Contract #W535 ac-22 352, 15 Nov. 1941.

77. Ltr., John K. Northrop, Pres., Northrop Aircraft Inc. to Hq. AAF, 21 Aug. 1942.

78. IOM, Col. F. O. Carroll to AC/S (E), Mat. Comd., Washington, 20 Aug. 1942; ltr., I. M. Laddon, Exec. V.P., Consolidated Aircraft Corp. to WD, Hq. AAF, attn.: Col. John F. Whiteley, 8 Sept. 1942; ltr., Northrop to Hq. AAF, cited in n. 77; ltr., Brig. Gen. L. S. Kuter, DC/AS to CG Mat. Comd., 28 Sept. 1942; memo for DC/AS from Gen. Echols, 30 Sept. 1942.

79. Lecture by Gen. F. O. Carroll on Research and Development, 5 July 1943.

80. Memo for Brig. Gen. Perrin, DC/AS from Gen. Chidlaw, 28 Dec. 1943.

81. Ltr., I. M. Laddon, Exec. V.P., Consolidated Aircraft Corp. to Gen. Echols, 1 Aug. 1942; memo for MD, MM&D (attn.: Gen. Chidlaw) from Gen. Echols, 19 June 1943; WD Contract #W33-038 ac-7(10971), 19 Aug. 1943.

82. Ltr., Col. J. F. Whiteley, TAI to CG AAF, 27 Aug. 1942; Hist. Off., AMC, Case Hist. B-36 Airplane, May 1949, p. 4; memo for C/AS (thru DC/AS, Gen. Perrin) from Brig. Gen. M. E. Gross, C/Req. Div., OC&R, 22 Mar. 1944; DAR, MD, M&S, 20 Sept. 1944.

83. Rpt. of XB-36 Airplane Initial Flight Test, Consolidated Vultee Aircraft Corp., 9 Aug. 1946; Engr. Div., AMC, TSEST-A3, 15 Nov. 1946.

84. DAR, MD, M&S, 23 May 1945; memo for C/AS from Gen. Powers, M&S, 2 June 1945; Case Hist. of B-36, pp. 5–6.

85. Robert Schlaifer and S. D. Heron, *Development of Aircraft Engines and Fuels* (Boston, 1950), p. 321.

86. Annual Rpt. of C/AC, FY 1939, pp. 63–64.

87. Ltr., Maj. B. E. Meyers, Exec. MD to Tech. Exec. (attn.: C/Exp. Engr. Sec.), Wright Fld., 1 Mar. 1941.

88. Schlaifer and Heron, pp. 446–50, 477, 479.

89. Ltr., Meyers to Tech. Exec., cited in n. 87; Schlaifer and Heron, pp. 457–58.

90. Schlaifer and Heron, pp. 458–59.

91. 1st Lt. Ezra Kotcher, Exp. Engr. Div., Mat. Comd., Memo Rept. on Jet Propulsion Mtg., 27 Nov. 1942.

92. Arnold, *Global Mission*, pp. 242–43; memo for US/W from Arnold, Tab A, Résumé of the Original AAF Jet-Propelled Airplane and Later Developments, 27 Oct. 1943.

93. Ltr., Arnold to Vannevar Bush, NACA, 25 June 1941; Schlaifer and Heron, pp. 460–61.

94. Ltr., Sir Henry Self to Hon. H. L. Stimson, 22 Sept. 1941; ltr., Stimson to Self, 9 Oct. 1941.

95. Arnold, *Global Mission*, pp. 242–43; memo for US/W from Arnold, cited in n. 92; Direc., Gen. Spaatz to Gen. Echols, 5 Sept. 1941.

96. Ltr., Gen. Chidlaw to General Electric Corp., 26 July 1943.

97. Ltr., Gen. Carroll, C/Engr. Div., Mat. Comd. to Gen. Chidlaw, MM&D, Hq. AAF, 24 Apr. 1943; informal memo for Col. Beebe from Col. Chidlaw, 5 June 1942; ltr., Arnold to Maj. Gen. H. C. Davidson, CG 10th AF, 20 Mar. 1944.

98. Memo rpt. for Gen. Echols and record by Col. Chidlaw, 7 Oct. 1942.

99. R&R, Col. Chidlaw to Tech. Exec. Mat. Comd., Wright Fld., 7 Oct. 1942.

100. Memo rpt. on Jet Propulsion, cited in n. 91.

101. Memo rpt. cited in n. 98; Schlaifer and Heron, p. 491.

102. Hist. Off., AMC, Development and Production of Fighter Aircraft for the U.S. Air Force, Oct. 1949, pp. 107–9; lecture by Gen. Carroll, 5 July 1943.

103. Memo for US/W from Arnold, Tab A, 27 Oct. 1943; lecture by Gen. Carroll, 5 July 1943; Schlaifer and Heron, pp. 472–73; WD Contract #535 ac-40680, 16 Oct. 1943; ltr., Gen. Carroll to CG AAF, attn.: MM&D, Development Engr. Br., 23 Dec. 1943.

104. R&R, AC/AS MM&D to CG AAF, 16 Feb. 1944; Flight Test Engr. Br. Memo Rpt. #Eng-47-1720-A, Preliminary Flight Tests of the XP-80 Airplane, 13 Mar. 1944.

105. Schlaifer and Heron, pp. 474–75; Supplement 2 WD Contract #W535 ac-

40680, 16 Feb. 1944; WD Contract #W33-038 ac-2393, 1 July 1944.

106. Ltr., Gen. Echols to Gerard Swope, General Electric Corp., New York, 19 June 1944; ltr., Gen. Giles to Gen. Spaatz, 14 Feb. 1945; ltr., Clarence L. Johnson, Lockheed Aircraft Corp., to CG Mat. Comd., 19 June 1944.

107. DAR's, MD, M&S, 26 July, 5 Dec. 1944, 4 Jan. 1945.

108. Memo for C/S from Gen. Giles, 19 Jan. 1945; AAF Stat. Digest, p. 118; ltr., Gen. Giles to Gen. Spaatz, 14 Feb. 1945.

109. Gen. Carroll, Rpt. on Jet Propulsion Projects, 15 Jan. 1944; ltr., Col. R. C. Wilson, MM&D to CG AAF Mat. Comd., attn.: Tech. Exec., 17 Jan. 1944; DAR's, M&S, 9 Mar., 21 Mar., 15–16 Apr. 1945.

110. DAR, MD, M&S, 28 Oct. 1944; Schlaifer and Heron, pp. 470–79.

111. DAR, MD, M&S, 16 June 1945; C/Engr. Div., ATSC, Rpt. No. TSEST-A7, Army Model Designations, 1 June 1946, p. 18 [hereinafter cited TSEST-A7]; ltr., Brig. Gen. L. C. Craigie, C/Engr. Div., ATSC to CG AAF, attn.: AC/AS-4, 14 Nov. 1945.

112. Memo, AAF Jet Propulsion Aircraft, n.s., n.d. but probably Dec. 1944, pp. 2–4; TSEST-A7, pp. 78–80; Development and Production of Fighter Aircraft, cited in n. 102, pp. 112–18.

113. Schlaifer and Heron, pp. 475–76, 490–92; Memo Rpt. on Jet Propulsion, cited in n. 91.

114. Memo for AS/WA from Brig. Gen. R. C. Hood, Jr., DC/AS, app. III, 3 July 1945.

115. Ltr., Brig. Gen. A. W. Robins, C/MD to C/AC, 10 Aug. 1935; Summary of Power Driven Weapons developed by Special Weapons Branch, Equipment Laboratory, Mat. Comd., 20 Nov. 1943.

116. Hist. Div., AMC, The Development of Guided Missiles, June 1946, Part II, pp. 1–2 [hereinafter cited Guided Missiles]; ltr., C. F. Kettering, Gen. Mgr., Research Laboratories Div., GM Corp. to Col. Grandison Gardner, CO Eglin Fld., Fla., 12 May 1942.

117. Guided Missiles, Part II, pp. 4–6.

118. *Ibid.*, pp. 7–14; DAR, M&S, 30 Dec. 1944.

119. DAR, MD, M&S, 28 Mar. 1945; Guided Missiles, Part II, p. 11.

120. Extracts from OSRD Rpt. on Jet Propulsion attached to memo for Gen. [H. A.] Craig and Gen. Giles from Gen. Gross, 27 Apr. 1944.

121. Ltr., Gen. Craig to Pres., AAF Bd., 25 Aug. 1945; R&R, Maj. Gen. H. R. Oldfield, Sp. Asst. for AA to AC/AS OC&R, Req. Div., 27 Nov. 1944.

122. Vannevar Bush, *Modern Arms and Free Men* (New York, 1949), p. 77.

123. DAR's, MD, M&S, 4, 6, 7 July 1944; memo for C/AS thru ACO from Gen. Echols, 7 July 1944.

124. Memo for Arnold from Lovett, 2 Aug. 1944; DAR, M&S, 9 Sept. 1944.

125. DAR, MD, M&S, 19 Oct. 1944; memo for AC/AS M&S, Off. of Tech. Info. from Lt. Col. V. A. Stace, 11 Aug. 1945.

126. R&R, Gen. Gross to MD, M&S, 13 Oct. 1944; memo for AC/S OPD from Gen. Giles, n.d. but between 15 and 18 Jan. 1945; memo for rcd., OPD, n.s., 19 Jan. 1945; memo for CG AAF from Maj. Gen. J. E. Hull, AC/S OPD, 20 Jan. 1945; draft of radio msg., Marshall to Eisenhower, 23 Jan. 1945.

127. DAR's, MD, M&S, 14 Feb., 31 Mar. 1945; memo for C/AS from Brig. Gen. E. M. Powers, Dep. AC/AS M&S, 15 Feb. 1945; memo for AC/S OPD from CG AAF, 22 Feb. 1945; memo for CG ASF from Maj. Gen. R. L. Maxwell, AC/S G-4, 9 May 1945; memo for AC/AS M&S, Off. of Tech. Info. from Lt. Col. V. A. Stace, 11 Aug. 1945; memo for C/S from Brig. Gen. R. C. Hood, DC/AS, 26 Nov. 1945.

128. TSEST-A7, p. 23; Guided Missiles, Pt. II, pp. 43–45.

129. See sources cited in n. 128.

130. Diary, C/AS, 27 June 1941; Guided Missiles, Pt. II, pp. 15–16; ltr., S/W to S/Navy, 15 Apr. 1941.

131. Diary, C/AS, 27 June 1941; ltr., Lt. Col. Randolph P. Williams to Asst. C/MD, Wright Fld., 17 Nov. 1941; Lt. Col. Randolph P. Williams, memo rpt. on Controllable Bomb Projects, EXP-M-54-673-4F, 13 Dec. 1941; ltr., Brig. Gen. Grandison Gardner to Capt. George J. Fix, Hq. AAF, 9 Feb. 1943.

132. Ltr., Gardner to Fix, cited in n. 131; memo for AC/AS Plans from Brig. Gen. B. E. Meyers, C/S Mat. Comd., 5 Sept. 1942.

133. TSEST-A7, p. 21; R&R, OPD to D/MR, 21 Nov. 1942; note for Gen. [Davenport] Johnson from M.E.G. [Col. Mervin E. Gross], 19 Dec. 1942; memo for CG Mat. Comd. from Brig. Gen. O. A. Anderson, Hq. AAF, 8 Oct. 1942.

134. Memo for CG AAF from Gen. O. A. Anderson, AC/AS Plans, 2 Mar. 1943; R&R, Gen. Giles, AC/AS OC&R to AC/AS MM&D, 18 May 1943; memo for Gen. Craig from AC/AS OC&R, Req. Div., 11 Sept. 1943; MD, MM&D, Details of AAF Guided Missiles Program, 1 July 1944, p. 6; ltr., Col. R. C. Wilson, M&S to CG Mat. Comd., 1 Sept. 1944.

135. TSEST-A7, p. 22; ltr., Col. R. C. Wilson, MM&D to CG Mat. Comd., 23 Oct. 1943; Mat. Comd., Details of AAF Guided Missiles Program, 2 Sept. 1944; memo for C/S from Brig. Gen. R. C. Hood, DC/AS, 20 Nov. 1945.

136. TSEST-A7, p. 21; Guided Missiles. Pt. II, pp. 21–33; Baxter, *Scientists*, pp. 195–96.

137. MD, MM&D, Details of AAF Guided Missiles Program, 1 July 1944, p. 3; memo for C/S from Hood, cited in n. 135.

138. Memo for C/AS from Brig. Gen. Donald W. Wilson, AC/AS OC&R, 10 Nov. 1944; ltr., Hugh H. Spencer, C/Div. 5, NDRC to Dr. Robert L. Stearns, C/Opns. Analysis Sec., 20th AF, 10 May 1945.

139. Ltr., Brig. Gen. L. C. Craigie, Dep. C/Engr. Div., Hq. ATSC to CG AAF, 21 Mar. 1945; memo for Brig. Gen. J. F. Phillips, C/MD, M&S from Col. Fred R. Dent, C/Engr. Br., MD, M&S, 7 June 1945; ltr., Col. H. G. Bunker, M&S to CG ATSC, 11 Aug. 1945; memo for C/S from Hood, cited in n. 135; Baxter, pp. 196–97.

140. Guided Missiles Com., Joint Com. on New Weapons and Equipment, JCS, Summary Handbook of Guided Missiles, GMC 4/4, 1 July 1945.

141. See, for example, the memo for Gen. Echols from Col. J. F. Phillips (for Gen. Chidlaw), 1 Mar. 1944.

142. Ord. Dept. Guided Missiles Program, July 1945, pp. 1–2.

143. DAR, MD, MM&D, 14 Aug. 1944; memo for Gen. Arnold from Lovett, 2 Aug. 1944; R&R, Gen. Wilson, Actg. C/AS to AC/AS M&S, 17 Aug. 1944 and Comment 2, Echols to Wilson, 25 Aug. 1944; memo for Lovett from Arnold, 17 Aug. 1944.

144. R&R, Maj. Gen. H. R. Oldfield, Sp. Asst. for AA to Brig. Gen. H. McClelland, ACO, 22 Aug. 1944; draft R&R, AC/AS M&S (by Col. J. F. Phillips) to AC/AS OC&R, 5 Sept. 1944.

145. Memo for US/W from Lt. Gen B. M. Giles, C/AS, 7 Sept. 1944; ltr., Giles to Off. C/Ord. 7 Sept. 1944.

146. Memo for DC/S from Brig. Gen. William A. Borden, NDD, 26 Sept. 1944; DAR's, M&S, 14, 19, 20 Sept. 1944; memo for CG AAF from Lt. Gen. Joseph T. McNarney, DC/S, 2 Oct. 1944.

147. Memo for file: Notes on AAF Mtg. for Discussion of Problems in Development of Guided Missiles, by T. W. D., 27 Nov. 1944; Joint Com. on New Weapons and Equipment, Direc., Formation of a Guided Missiles Com., 16 Jan. 1945 (JNW 32/D); memo for C/S from Gen. Giles, 9 Mar. 1945.

148. Memo for AC/S G-3 from Maj. Gen. J. E. Hull, AC/S OPD, 16 Mar. 1945; memo for CG's AAF, AGF, ASF from Maj. Gen. I. H. Edwards, AC/S G-3, 19 Mar. 1945; memo for rcd., n.s., OPD, 26 Mar. 1945; memo for AC/S G-3 from DC/S (sgd. Brig. Gen. H. I. Hodes, Asst. DC/S), 21 June 1945; memo for C/S (attn.: G-3) from Brig. Gen. Patrick W. Timberlake, DC/AS, 23 Mar. 1945.

149. R&R, Lt. Col. L. T. Bradbury, C/Engr. Br., Prod. Div., AC/AS-4 to Req. Div., AC/AS-3, 24 Aug. 1945.

150. Memo for C/AS from Gen. Powers, 14 Sept. 1945.

151. Ltr., Brig. Gen. A. R. Crawford, Actg. AC/AS-4 to CG ATSC, 7 Dec. 1945.

NOTES TO CHAPTER 8

1. House Approp. Comm., 76 Cong., 3 Sess., Report No. 1912; Defense for the Inclusion of Approximately $23,000,000 in Appropriations, Air Corps, Army, FY 1941, n.s. 7 May 1940.

2. Memo for Gen. Yount from Col. Spaatz, 9 May 1940; Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations* (Washington, D.C., 1950), p. 149 ff. For an interesting discussion of the cautious thinking of Air Corps officers, see

H. H. Arnold, *Global Mission*, pp. 172–73.

3. Memo for Gen. Yount from Col. Spaatz, 9 May 1940; memo for C/S from Arnold, 14 May 1940; memo for Col. [D.W.?] Wilson from Gen. Yount, 28 May 1940.

4. Memo for C/S from Arnold, 14 May 1940.

5. Memo for Brig. Gen. Frank M. Andrews, WDGS G-3 from Arnold, 1 June 1940; memo for Col. Wilson from Gen. Yount, 28 May 1940.

6. Robert E. Sherwood, *Roosevelt and Hopkins* (New York, 1949), p. 161.

7. Memo for Gen. Strong, AC/S WPD from Lt. Col. Thos. T. Handy, WPD, 5 June 1940; memo for C/S from Arnold, 5 June 1940; memo for Gen. Marshall from Brig. Gen. Wm. Bryden, Actg. DC/S, 28 May 1940.

8. R&R, Spaatz to Exec. OCAC, 5 Apr. 1940.

9. Memo for Mr. Knudsen from Marshall, 13 June 1940.

10. Memo for C/S from Arnold, 19 June 1940.

11. Memo for Mr. Knudsen from Louis Johnson, AS/W, 20 June 1940.

12. Ltr., TAG to C/AC, AG 580 (6-28-40), 29 June 1940.

13. Memo for AC/S G-4 from AC/AC, 20 July 1940.

14. *Ibid.*

15. Memo for Exec. OCAC from Gen. Yount, 9 July 1940; memo for AC/S G-3 from Gen. Brett, 11 July 1940.

16. Memo for Mr. Knudsen from Robert P. Patterson, AS/W, 10 Aug. 1940.

17. Memo for C/S from Col. J. W. Anderson, Actg. AC/S WPD, 21 Oct. 1940; Mat. Planning Sec., MD, Summary of Procurements Requirements and all Air Corps Programs, 11 Sept. 1940.

18. Memo for C/S from Lovett, 21 Mar. 1941.

19. Min., OCAC staff mtg., 29 Aug. 1940.

20. Memo for AS/W from Arnold, 12 Aug. 1940.

21. Memo for C/AC from Patterson, 16 Oct. 1940; memo for Patterson from Arnold, 17 Oct. 1940; memo for Knudsen from Patterson, 17 Oct. 1940; ltr., Knudsen to the President, 12 Sept. 1940.

22. Memo for AS/W from C/S, 20 Dec. 1940.

23. Memo for AS/W from Brett, 10 July 1940; memo for C/AC from Col. G. E. Stratemeyer, Actg. C/Plans Div., OCAC, 24 Oct. 1940; memo for AS/W from Marshall, 20 Dec. 1940.

24. AHS-22, Legislation Relating to the AAF Materiel Program, 1939–1944, pp. 38–44.

25. Memo for AC/S G-3 from C/S, 9 Nov. 1940; memo for AS/W from Marshall, 20 Dec. 1940.

26. Diary of Col. G. E. Stratemeyer, 12 Mar. 1941; ltr., WD to CG GHQ AF and C/AC, 14 Mar. 1941.

27. Notes for Stat. Sec., Off. DC/S, n.s. but probably Maj. A. J. Lyon, 3 Apr. 1941, p. 2.

28. AAF Stat. Digest, p. 135.

29. Draft memo for C/S, n.s. but probably Arnold, 16 Dec. 1940.

30. Memo for AS/W from C/S, 20 Dec. 1940.

31. Ltr., Sir Henry Self to Arnold, 8 Apr. 1941; ltr., Roosevelt to Stimson, 4 May 1941.

32. Speech by Gen. Echols, Off. Club, Bolling Fld., 2 Apr. 1941. See also memo for C/S from Arnold, Mar. 1941; memo for Arnold from Marshall, 16 July 1941; memo for S/W from Gen. Marshall, 29 Aug. 1941; memo for C/S from Arnold, 17 Sept. 1940.

33. Hist. AAF Mat. Comd., 1926 thru 1941, pp. 22–36.

34. Purchasing and Contracting Direc. #81, US/W to C/AC, 17 Dec. 1941.

35. See Harry L. Yoshpe, Study of Experience in Industrial Mobilization in World War II, Plans for Industrial Mobilization, 1920–1939, Army Industrial College, pp. 15–16.

36. Civ. Production Admin., *Industrial Mobilization for War* (Washington, 1947), p. 24; Arnold, *Global Mission*, pp. 184–86; memo for AS/W from Arnold, 14 Mar. 1940.

37. *Industrial Mobilization for War*, pp. 18 ff.; Carlyle Sitterson, *Aircraft Production Policies Under the National Defense Advisory Commission and Office of Production Management, May 1940 to December 1941* (Washington, 1946), pp. 4 ff.

38. Ltr., sgd. by Gen. Marshall, C/S

and Adm. Stark, CNO, 16 May 1940.

39. Memo for S/W from C/AC, 22 July 1940; memo for AS/W from C/AC, 9 Aug. 1940; memo for Mr. Knudsen from Robert P. Patterson, AS/W, 10 Aug. 1940; memo for Brig. Gen. Richard C. Moore, DC/S, 13 Sept. 1940.

40. Min., JAC, 12 Mar. 1941; ltr., S/W to Arnold, 22 Apr. 1941.

41. Sitterson, *Aircraft Production Policies,* pp. 16–21; History of the Aircraft Resources Control Office of the Aircraft Production Board and Predecessor Agencies, May 1940–September 1945, pp. 13–16.

42. Watson, *Chief of Staff,* p. 326; memo for S/W from Patterson, 18 Apr. 1941.

43. Watson, *Chief of Staff,* pp. 337–38.

44. *Industrial Mobilization for War,* pp. 134–37.

45. Ltr., Roosevelt to S/W, 9 July 1941.

46. Memo, President to S/W, 30 Aug. 1941, quoted in Watson, *Chief of Staff,* pp. 348–49.

47. Watson, *Chief of Staff,* pp. 349–51.

48. Joint Board Estimate of United States Over-all Production Requirements, 11 Sept. 1941, app. II, pt. III.

49. Ltr., Stimson to Roosevelt, 23 Sept. 1941.

50. Memo for Adm. Stark, CNO from Brig. Gen. L. T. Gerow, ACS/WPD, 29 Dec. 1941.

51. Memo for S/W (thru C/S) from Lovett, 12 Dec. 1941.

52. AWPD/4, 15 Dec. 1941, p. 9.

53. Memo for C/AS from Plans Div., 1 Jan. 1942; *Industrial Mobilization for War,* p. 277; Donald Nelson, *Arsenal of Democracy* (New York, 1946), pp. 185–87.

54. Ltr., Roosevelt to Stimson, 3 Jan. 1942.

55. *Ibid.*

56. 77 Cong., 2 Sess., Address of the President of the United States, H. Doc. 501, 6 Jan. 1942, pp. 3–4.

57. Memo for C/S from Arnold, 7 Jan. 1942.

58. Memo for Col. L. W. Miller, Bud. Off., Hq. AAF from Col. B. E. Meyers, 9 Jan. 1942.

59. *Ibid.;* Norma Beasley, *Knudsen* (New York, 1947), p. 337.

60. Memo for Gen. Gerow from Lt. Col. A. C. Wedemeyer, 7 Jan. 1942; memo for C/S from Gen. Somervell, AC/S G-4, 7 Jan. 1942.

61. Memo for US/W from Lovett, 12 Jan. 1942; memo for Mr. Patterson from F.D.R., 14 Jan. 1942.

62. AHS-22, pp. 49–54.

63. Draft memo for DC/S from Arnold, 5 July 1942.

64. Ltr., Roosevelt to Nelson, 1 May 1942.

65. Ltr., Nelson to Roosevelt, 24 Aug. 1942.

66. Memo for Marshall from Roosevelt, 24 Aug. 1942.

67. Memo for C/S from Arnold, 9 Sept. 1942, in AWPD/42, Requirements for Air Ascendancy.

68. Memo for the President (via Adm. Leahy) from Adm. E. J. King, 24 Sept. 1942; memo for the President from Marshall, 24 Sept. 1942; Daily Diary of Brig. Gen. L. S. Kuter, 18 Sept.–1 Oct. 1942.

69. Ltr., Joint Aircraft Planning Com. (sgd. by Robert Nathan and Mordecai Ezekiel) to Donald M. Nelson, C/WPB, 28 Sept. 1942.

70. Memo for JCS from Roosevelt, 1 Oct. 1942.

71. Memo for C/S from Somervell, 17 Oct. 1942.

72. Memo for JCS from Nelson, 19 Oct. 1942.

73. Memo for AS/WA from Arnold, 20 Oct. 1942; memo for JCS from Arnold, 20 Oct. 1942; memo for JPS from S/JCS, 23 Oct. 1942.

74. Ltr., Roosevelt to Nelson, 29 Oct. 1942.

75. Ltr., Adm. Leahy (for JCS) to Donald M. Nelson, 26 Nov. 1942; memo for Gen. Meyers from Col. C. P. Cabell, 27 Nov. 1942; min., JCS mtgs., Oct. and Nov. 1942.

76. Min., JCS mtgs., Oct. and Nov., 1942; *Industrial Mobilization for War,* pp. 291–322.

77. Meeting with Gen. Arnold on the Question of the Saturation Point of the Air Power of the United States, 22 Dec. 1942.

78. Memo for All Concerned from Arnold, 5 Jan. 1943.

79. Civ. Prod. Admin., Official Munitions Production of the United States

by Months, July 1, 1940–Aug. 31, 1945, 1 May 1947, p. 1.

80. Comment #4, R&R, Echols to D/MR, 30 Jan. 1943, and Comment #5, Johnson to C/AS, 5 Feb. 1943. See also, memo for Lovett from Arnold, 22 Feb. 1943.

81. Memo for Actg. Chmn., JAC from Stratemeyer, 17 Mar. 1943.

82. Quoted in memo for Brig. Gen. L. G. Saunders *et al.* from Brig. Gen. T. J. Hanley, Jr., DC/AS, 9 Apr. 1943.

83. Ltr., Lovett to Hopkins, 25 Mar. 1943.

84. Memo for C/S (attn.: OPD) from Arnold, 22 Mar. 1943.

85. *Industrial Mobilization for War,* pp. 605–6, 609–10.

86. Ltr., Leahy (for JCS) to Nelson, n.d. but probably July 1943.

87. Min., JCS mtg., 8 June 1943; Notes Taken at a Luncheon Meeting of the JCS and Chairmen of Civilian War Agencies, Tuesday, 15 June 1943, pp. 3–5.

88. R&R, Arnold to Hanley, DC/AS, 26 Apr. 1943.

89. Memo for Mr. Lovett from Brig. Gen. L. S. Kuter, AC/AS Plans, 11 July 1943; memo for CG AAF from Kuter, 21 July 1943; mtg., on the Air Force Program, held in Room 3E-1072 [Pentagon], 1 July 1943, pp. 1–2.

90. Memo for Gen. Arnold from Col. E. O'Donnell, 14 July 1943.

91. Memo for Gen. Giles from AC/S OPD, 10 Dec. 1943; JCS 677, 22 Jan. 1944; WD Victory Program Troop Basis, 22 Nov. 1943.

92. Public Law 108, 1 July 1943.

93. Memo for CG's AAF, AGF, ASF from C/S, 22 Nov. 1943; memo for C/S (attn.: OPD) from Gen. Giles, 26 Aug. 1944; memo for Maj. Gen. T. T. Handy, AC/S OPD from Brig. Gen. P. H. Tansey, C/Log. Gp., OPD, 2 Sept. 1944.

94. AAF Stat. Digest, pp. 5–7.

95. MD, OCAC, Air Corps Airplanes Purchased, FY's 1936 to 1940, 29 Apr. 1940; Teletype DHQ-T-977, Echols to Brett, 18 July 1940; memo for Gen. Brett, OCAC from Gen. Echols, C/MD (sgd. M. E. Gross), 10 Jan. 1941.

96. Hist. ARCO, 29 Sept. 1945, p. 4–5.

97. *Ibid.*, p. 33.

98. Sitterson, *Aircraft Production Policies,* pp. 35–36, 50–58.

99. Hist. ARCO, pp. 33–34; memo for Col. L. W. Miller, Bud. Off., Hq. AAF from Col. B. E. Meyers, 9 Jan. 1942; interview with Dr. Albert E. Lombard, Jr., 23 Dec. 1952; ARCO, Comparison of Various Airframe Schedules, 1945; Beasley, *Knudsen,* p. 337.

100. Hist. ARCO, pp. 33–34.

101. *Ibid.*, pp. 34–35.

102. *Ibid.*, pp. 35–38; min., Aircraft Prod. Bd. mtgs., 12 July 1943, 14 Aug. 1944.

103. Hist. ARCO, pp. 35–38; Notes on the Factors Considered in Preparing Estimates of Airplane Deliveries, n.s., n.d., but probably Aug. or Sept. 1942; Capt. L. L. Strauss and Col. W. H. Draper, Coordination of Procurement Between the War and Navy Departments, Feb. 1945, Vol. III; War Production in 1944, Report of the Chairman of WPB (Washington, 1945), p. 93.

104. For a detailed discussion of its work, see The Aircraft Scheduling Unit, 30 Sept. 1945.

105. *Industrial Mobilization for War,* pp. 222–26.

106. Report of the Procurement Review Board, 31 Aug. 1943; MAC (Air), Organization and Functions, n.d. but probably Aug. 1943.

107. Memo to Recorder, JAC from Subcommittee on Production Programs, 25 Feb. 1943.

108. Hist. ARCO, pp. 22–23.

109. *Ibid.*, pp. 27–30.

110. Troyer S. Anderson, *Munitions for the Army,* p. 24. For a discussion of the US/W down to 1941, see Troyer S. Anderson, History of the Office of the Under Secretary of War (1914–1941).

111. For a discussion of AAF-SOS relations, see John D. Millett, *Organization and Role of the Army Service Forces,* U.S. Army in World War II (Washington, 1954).

112. See histories of the Mat. Comd., ASC, and ATSC.

113. Memo for C/AS from Echols, 19 May 1943. See also AHS-10, Organization of the Army Air Arm, 1935–1945.

114. Histories Mat. Comd. thru 1943 and Hist. ATSC, 1944.

115. See sources in n. 114 and histories of the procurement districts.

116. Report of Study of Duplication

of Army Air Forces and Naval Air Forces, prepared for AS/WA, 29 Jan. 1944.

117. *Wall Street Journal*, 12 Oct. 1942, p. 4, 14 Apr. 1943, p. 5; Frank J. Taylor and Lawton Wright, *Democracy's Air Arsenal* (New York, 1947), pp. 44–49.

118. Taylor and Wright, *Air Arsenal*, pp. 46–47.

NOTES TO CHAPTER 9

1. For full discussions, see Industrial Mobilization Planning Div., AMC, Pre-World War II Industrial Preparedness, 10 Mar. 1948, *passim*, and Harry Yoshpe, Study of Experience in Industrial Mobilization in World War II, Army Industrial College, pp. 21–26.

2. Yoshpe, Industrial Mobilization, pp. 28–30; 52 *Stat.* 707; 53 *Stat.* 560.

3. Memo for AS/W from Arnold, 25 July 1939; notes for Gen. Arnold from Maj. A. J. Lyon, 1 Nov. 1939; memo for AS/W from Arnold, 27 Dec. 1939; ltr., Lt. Col. George S. Warren, C/Mat. Planning Sec., OASW to Ainsworth Mfg. Corp., Detroit, Mich., 14 Nov. 1940; Annual Rpt. of the Planning Br., US/W, Brig. Gen. Charles Hines to US/W, 25 July 1941; memo for Donald Nelson, NDAC from R. P. Patterson, US/W, 9 Apr. 1941.

4. Memo for Arnold from Lt. Col. R. L. Walsh, 23 Aug. 1939; memo for AS/W from Arnold, 25 July 1939; Pre-World War II Industrial Preparedness, p. 105; memo for Lt. Col. William C. Young from Maj. Myron R. Wood, OASW, 7 Mar. 1940.

5. Annual Rpt. of Planning Br., OASW, FY 1940, 12 Aug. 1940; Annual Rpt. of Planning Br., US/W, 25 July 1941; Pre-World War II Industrial Preparedness, p. 44.

6. Memo for Gen. Brett from Lt. Col. W. F. Volandt, 11 Sept. 1939; ltr., Robert E. Gross, Pres., Lockheed Aircraft Corp. to Louis Johnson, AS/W, 12 Dec. 1939.

7. Chron. incl. to memo for Marshall from Brett, 19 Dec. 1940; Mat. Planning Sec., Airplanes Released to Foreign Purchasers, 1 Jan. 1938 to 29 Feb. 1940, 26 Mar. 1940.

8. Memo for AS/W from Arnold, 14 Mar. 1940; memo for S/W from Arnold, 21 Mar. 1940; ltr., AG452 to chiefs of all divs. in WDGS, 29 Mar. 1940; ltr., Gen. Brett to Rear Adm. J. H. Towers, C/BuAer, 25 Apr. 1940; ltr., WD to QMG, 1 Apr. 1940.

9. Memo for AS/W from Arnold, 23 July 1940; incl. to memo for Marshall from Brett, 19 Dec. 1940.

10. Incl. to memo for Marshall from Brett, 19 Dec. 1940.

11. AHS-106, Distribution of Air Materiel to the Allies, 1939–1944: Controls, Policies, and Procedures, p. 25, n. 65.

12. See *New York Times* and *Wall Street Journal* for 1939–1940, e.g., *New York Times*, X (7 Jan. 1940), 6, IV (11 Feb. 1940), 6. See also *Fortune*, Mar. 1940, p. 69.

13. *Wall Street Journal*, 7 Sept. 1940, p. 1.

14. Rudolf Modley, ed., *Aviation Facts and Figures 1945* (New York, 1945), p. 2.

15. Incl. to ltr., S/W Stimson to Sen. Alben W. Barkley, 17 Feb. 1941; Tom Lilley *et al.*, *Problems of Accelerating Aircraft Production During World War II* (Boston, 1947), p. 7.

16. Memo for C/AC from Johnson, 22 Dec. 1938.

17. Memo for AS/W from Arnold, 26 July 1939; ltr., Arnold to TAG, 5 Mar. 1941; min., OCAC staff mtg., 12 Feb. 1940.

18. Memo for AS/W from Arnold, 6 Sept. 1939.

19. Misc. Data for the 5,500 Plane Program, n.s. but probably Maj. A. J. Lyon, n.d. but late 1939; memo for AS/W from Arnold, 23 Jan. 1940; memo for AS/W from Brig. Gen. B. K. Yount, AC/AC, 7 Feb. 1940.

20. Draft memo by Maj. A. J. Lyon, 13 May 1940.

21. Notes on conf. held between representatives of the aircraft industry and various government representatives at the Treasury Dept., 20 May 1940; telephone conversation between Mr. Hartson, of Glenn L. Martin Co., and Brett, 7 June 1940; memo for S/T from Brett, 21 May 1940.

22. Memo for Dr. George J. Mead, C/Aero. Sec., NDAC from Arnold, 26 June 1940; Lt. Col. A. J. Lyon, memo,

Government-Owned Factories, n.d., but early 1941.

23. Col. W. F. Volandt, memo on Status of Airplane Procurement, 18 Aug. 1940; Public Law 671, 76 Cong.; Conf. in Federal Reserve Bd. Room, 30 July 1940, recorded by Capt. W. W. Webster, BuAer. This story can be traced in the *Wall Street Journal* and *New York Times*, June–Oct. 1940.

24. Volandt, memo on Status of Airplane Procurement; J. Carlyle Sitterson, *Aircraft Production Policies* (Washington, 1946), pp. 42–49; Norman Beasley, *Knudsen* (New York, 1949), pp. 248–50; Donald M. Nelson, *Arsenal of Democracy* (New York, 1946), pp. 105–7.

25. Public Law 801, 8 Oct. 1940; Sitterson, pp. 42–49; House, Hearings on Second Supplemental National Defense Appropriation for 1941 (H.R. 10263), 76 Cong., 3 Sess., pp. 251–52; memo for Arnold from Patterson, 25 Sept. 1940; Nelson, *Arsenal of Democracy*, pp. 105–7; *Wall Street Journal*, 27 Aug. 1940, p. 4; memo for AS/W from Brett, 10 July 1940.

26. Sitterson, pp. 44–45; conf. cited in n. 23; memo for C/S from C/AC, 15 Aug. 1940.

27. Ethan P. Allen, Policies Governing Private Financing of Emergency Facilities, May 1940 to June 1942; Civ. Prod. Admin., WPB Special Study No. 12, pp. 45–46; Sitterson, p. 62; speech by Gen. O. P. Echols, Off. Club, Bolling Fld., 2 Apr. 1941; *Wall Street Journal*, 3 Sept. 1940, p. 1.

28. For the most comprehensive discussion of aircraft facilities expansion, see AHS-40, Expansion of Industrial Facilities under AAF Auspices.

29. AHS-40, pp. 74–77; Sitterson, pp. 46–47.

30. AHS-40, pp. 77–78; Sitterson, p. 47; Beasley, *Knudsen*, pp. 264–67; *Wall Street Journal*, 12 Sept. 1940, p. 1.

31. AHS-40, pp. 94–95; Sitterson, p. 144; memo, Engine Situation, n.s. but probably Maj. A. J. Lyon, n.d. but apparently 1941; OCAC staff mtg., 12 Feb. 1940.

32. Memo for AS/W from Arnold, 6 Sept. 1940; R&R, Brig. Gen. B. K. Yount, C/Plans Div. to C/AC, 18 Sept. 1940; memo for Pres. from AS/W, 16 Oct. 1940, and notation "O.K. F.D.R."

33. Beasley, *Knudsen*, p. 271.

34. Memo for Brett from Arnold, 9 Nov. 1940; Reginald C. McGrane, The Facilities and Construction Program of the War Production Board and Predecessor Agencies May 1940 to May 1945 (Nov. 1945), pp. 56–62; Nelson, pp. 150–51.

35. Memo for Gen. Spaatz from Arnold, 2 Dec. 1940; memo for Brett from Arnold, 9 Nov. 1940; memo for Arnold from Brett, 27 Dec. 1940; memo, Additional Production Capacity–Heavy and Medium Bombers, n.s. but probably Col. A. J. Lyon, Jan. 1941; Col. A. J. Lyon, memo, Government-Owned Factories, Jan. 1941; Sitterson, pp. 86–92; *Fortune*, Mar. 1941, p. 99; memo for Brett from Echols, 18 Feb. 1941.

36. Maj. A. J. Lyon, memo, Engine Situation, n.d. but late 1940; AHS-40, pp. 90–91; Lilley *et al.*, *Problems*, pp. 33–34.

37. Memo for S/W from Arnold, 26 Oct. 1940.

38. Memo by Robert A. Lovett, 30 Dec. 1940.

39. Memo for Arnold from Lovett, 4 Mar. 1941; Sitterson, p. 56.

40. AHS-40, pp. 91–93.

41. *Ibid.*, p. 93; memo for Knudsen from Patterson, 7 Apr. 1941.

42. Sitterson, pp. 100–101.

43. AHS-40, p. 107.

44. *Ibid.*, pp. 107–8.

45. Memo for the Chiefs of Supply Arms and Services from Patterson, 8 Dec. 1941; AHS-40, p. 109.

46. Memo for Gen. Echols from Lovett, 16 Dec. 1941; memo for Knudsen from Stimson, 7 Jan. 1941.

47. AHS-40, pp. 111–12.

48. *Ibid.*, p. 113; Modley, *Aviation Facts and Figures 1945*, p. 2; Rpt. of the Surplus Property Admin. to Congress, Aircraft Plants and Facilities, 14 Jan. 1946, p. 47 [hereinafter cited Aircraft Plants and Facilities].

49. AHS-40, pp. 126–35.

50. *Ibid.*, pp. 159–60, 169–70, 185–86; Aircraft Plants and Facilities, p. 45.

51. AHS-40, pp. 179–82; min., Aircraft Production Bd. mtgs., 7 June, 2 Aug. 1943; memo for CG AAF from Brig. Gen. B. E. Meyers, 2 May 1942; mtg.

with Gen. Arnold on question of saturation point of air power of United States, 22 Dec. 1942; *Fortune,* June 1942, p. 204.

52. AHS-40, pp. 183–84.

53. Rpt. of Chmn. WPB, Wartime Production Achievements and the Reconversion Outlook, 9 Oct. 1945, pp. 6–7, 31–35; AHS-40, pp. 229, 232.

54. Aircraft Plants and Facilities, pp. 8–9.

55. Modley, *Aviation Facts and Figures 1945,* p. 2; Lilley *et al., Problems,* pp. 88, 102; AHS-40, p. 219.

56. Lilley *et al., Problems,* pp. 34–36, 71.

57. AHS-40, pp. 223–27.

58. Annual Rpt. of C/AC, FY 1939, pp. 78–79; min., Quantity Production Conf., OCAC, 6 Sept. 1938, p. 3; Pre-World War II Industrial Preparedness, pp. 111–12; memo for AS/W from Arnold, 26 July 1939.

59. Sitterson, *Aircraft Production Policies,* p. 64; Beasley, *Knudsen,* p. 229; Nelson, *Arsenal of Democracy,* pp. 227–28; *Fortune,* Oct. 1941, p. 66.

60. Sitterson, *Aircraft Production Policies,* p. 64; memo for C/MD from Arnold, 21 Oct. 1940; Beasley, *Knudsen,* p. 285.

61. Capt. C. S. Irvine, Majs. George F. Schulgen and Thomas H. Chapman, Conf. on Airplane Production, 29 Oct. 1940.

62. AHS-40, pp. 87–88.

63. Memo for Arnold from Echols, 10 Jan. 1941.

64. AHS-40, pp. 87–88; min., OPM Council, 21 Jan. 1941.

65. Walter P. Reuther, 500 Planes a Day, American Council on Public Affairs, Washington, D.C., n.d. but Dec. 1940 or Jan. 1941.

66. See *Wall Street Journal,* 24 Dec. 1940, p. 13; 4 Jan. 1941, p. 4; 16 Jan. 1941, p. 1; 27 Jan. 1941, p. 3.

67. Memo for AS/W from Arnold, 4 Oct. 1940.

68. Civ. Prod. Admin., *Industrial Mobilization for War* (Washington, 1947), pp. 187–89; AHS-40, pp. 85–86.

69. *Industrial Mobilization for War,* pp. 187–88; Beasley, *Knudsen,* pp. 286–87.

70. Sitterson, *Aircraft Production Policies,* p. 66; AHS-40, pp. 90–91.

71. Memo by Robert A. Lovett, 30 Dec. 1940.

72. Min., OPM Council, 6 May 1941; IOM, Gen. Echols to Asst. C/MD, 1 May 1941; *Industrial Mobilization for War,* pp. 189–92.

73. *Industrial Mobilization for War,* pp. 191–97.

74. Sitterson, *Aircraft Production Policies,* p. 69; AHS-40, p. 93; *New York Times,* X (26 Oct. 1941), 6.

75. *Automobile Facts and Figures,* 26th ed., 1944 and 1945, pp. 4–5.

76. Min., WPB, 20 Jan. 1942, p. 1; *Automobile Facts and Figures,* 1942, pp. 34–37; *Automobile Facts and Figures,* 1943, p. 6.

77. Memo for Col. E. S Greenbaum, OUS/W from Col. Volandt, 15 Jan. 1943; *Automobile Facts and Figures,* 1943, p. 6.

78. AHS-40, pp. 122–24; *New York Times,* 8 Mar. 1942, p. 38; 7 June 1943, p. 31.

79. Aircraft Plans and Facilities, p. 40.

80. Civ. Prod. Admin., Official Munitions Production of the United States, 1 July 1940–31 Aug. 1945 (1 May 1947), pp. 59–70; Lilley *et al., Problems,* pp. 108–11.

81. Official Munitions Production of the United States, pp. 32–53; Lilley *et al., Problems,* p. 67.

82. *New York Times,* 20 May 1942, p. 10; 21 May, p. 10; 26 May, p. 16; 29 May, p. 7; *Wall Street Journal,* 4 Aug. 1942, p. 2.

83. *New York Times,* 20 May 1942, p. 10.

84. *Ibid.,* 29 May 1942, p. 7.

85. Min., Aircraft Production Bd., 25 Oct. 1943; min., AC/AS M&S staff mtg., 4 Sept. 1944.

86. Memo for Gen. Meyers from Gen. Knudsen, 21 Sept. 1943; memo for CG AAF from Meyers, 25 Sept. 1943; Lilley *et al., Problems,* pp. 48–50.

87. Official Munitions Production of the United States, p. 44; USSBS, Aircraft Industry Rpt., Strat. Bombing of the German Aircraft Industry, p. 79; *New York Times,* 29 Aug. 1942, p. 7; 26 May 1942, p. 16; Lilley *et al., Problems,* p. 90.

NOTES TO CHAPTER 10

1. Civ. Prod. Admin., Official Munitions Production of the United States, 1 July 1940–31 August 1945 (1 May 1947), pp. 1, 59; Rudolf Modley, ed., *Aviation Facts and Figures 1945* (New York, 1945), pp. 11, 14; Tom Lilley *et al.*, *Problems of Accelerating Aircraft Production During World War II* (Boston, 1947), pp. 102–5.

2. Modley, *Aviation Facts and Figures*, pp. 2, 20–21.

3. Lilley, pp. 39–40; Frank Taylor and Lawton Wright, *Democracy's Air Arsenal* (New York, 1947), p. 65.

4. Lilley, pp. 40–41; *Wall Street Journal*, 31 Jan. 1939, p. 13; 2 Apr. 1940, p. 7; *New York Times*, 4 Feb. 1940; *Fortune*, Mar. 1941, p. 172.

5. Ltr., Lovett to Robert Patterson, AS/W, 22 Nov. 1940.

6. Lilley, pp. 40–41; Taylor and Wright, *Democracy's Air Arsenal*, pp. 65–79.

7. Ford Motor Co., *Forty Years, 1903–1943*, pp. 40–41; Lilley, pp. 48–50.

8. DAR, AC/AS MM&D, 6 Mar. 1944; USSBS, German Aircraft Industry Rpt., p. 85, fig. VI-12 (following p. 93).

9. Avn. Hist. Unit, Op-501D, U.S. Navy, Inter-Service Cooperation in Aeronautics, 12 Oct. 1948, pp. 22–31; *Wall Street Journal*, 8 July 1940, p. 3.

10. Inter-Service Cooperation in Aeronautics, as cited in n. 9, pp. 31–36; speech by Gen. O. P. Echols, Off. Club, Bolling Fld., 2 Apr. 1941; Organization and Functionings of the Working Sub-Committee on Standardization of the JAC, 1 Jan. 1942.

11. Memo for C/MD from Arnold, 23 Apr. 1940; memo for Arnold from Giles, 9 May 1943.

12. Msg. #857, SPOBS to AGWAR (Brett to Arnold), 24 Oct. 1941.

13. Agenda for initial mtg. of JAAC, 27 May 1940; memo for C/S from C/AC, 21 Mar. 1940; speech by Gen. Echols, 2 Apr. 1941, cited in n. 10.

14. Memo for C/AS from Echols, 15 Jan. 1942.

15. Echols to OCAC, 2 Feb. 1942; Development of AAF Modification Centers (n.s., n.d. but apparently 1944), app. A; ltr., Arnold to C/AC, 5 Feb. 1942.

16. Rpt. of the Surplus Property Admin. to Congress, Aircraft Plants and Facilities, 14 Jan. 1946, p. 8; CG Mat. Comd. to D/MR, Hq. AAF, 7 July 1942; lecture by Col. Bryant L. Boatner at Industrial College of the Armed Forces, 11 Dec. 1946, p. 10; TWX, Gen. B. E. Meyers to Brig. Gen. K. B. Wolfe, Mat. Comd., 2 Aug. 1942.

17. Memo for OC&R from Brig. Gen. E. S. Perrin, 21 July 1943; memo for Gen. Gross from Gen. Chidlaw, 26 July 1943; 1st ind. (ltr., Hq. AAF to CG ASC, n.d. but Nov. 1942) Maj. Gen. W. H. Frank, CG ASC to CG AAF, 3 Dec. 1943; Hq. ASC to Hq. AAF, 18 Aug. 1942.

18. Min., MM&D staff mtgs., 16 Mar., 7 Apr. 1944; Daily Diary, M&S, 31 Aug. 1944.

19. Memo for CG AAF from Col. B. E. Gates, D/Management Control, Hq. AAF, 24 Aug. 1942; IOM, Col. J. W. Sessums to Gen. Echols, 17 Dec. 1942; memo for AC/AS MM&D from Gen. Hanley, DC/AS, 22 Apr. 1943; memo for Echols from Giles, 1 Dec. 1943; ltr., Giles to Doolittle, 10 Feb. 1945; lecture by Col. Boatner (cited in n. 16), p. 9; ltr., Maj. Gen. E. M. Powers, AC/AS-4, Hq. AAF to CG ATSC, 8 Sept. 1945.

20. Memo for AS/W from Arnold, 26 July 1939; min., OCAC staff mtg., 12 Feb. 1940.

21. Memo for AS/W from Arnold, 7 Sept. 1940; AHS-40, Expansion of Industrial Facilities Under Army Air Forces Auspices, 1940–1945, pp. 96–102.

22. *Wall Street Journal*, 7 Jan. 1942, p. 5; AHS-40, pp. 104–7.

23. Lilley, pp. 67–68; *Democracy's Air Arsenal*, pp. 66, 81, 88, 92; Ministry of Aircraft Production, Rpt. of British Mission to USA to Study Production Methods (Sept.–Oct. 1942), Sec. 1.

24. Lilley, p. 68.

25. *Ibid.*, p. 69.

26. *Ibid.*, p. 58; U.S. Dept. of Labor, Bulletin No. 800, Wartime Development of the Aircraft Industry, 1 Nov. 1944, pp. 4–5.

27. Memo for C/AC from Mat. Plans Sec., MD, 31 Jan. 1940; *Wall Street Journal*, 4 Sept. 1940, p. 3; Lilley, p. 69.

28. See, for example, memo rpts. for

Gen. Echols from Lt. Arthur K. Lovett, 1 Apr. 1941; *New York Times*, 11 June 1941, p. 13; 18 Mar. 1942, p. 18; *Fortune*, Mar. 1941, p. 190; *Wall Street Journal*, 9 May 1942, p. 3; Lilley, pp. 59–66; *Skyways*, Mar. 1943, p. 10; min., Aircraft Production Board mtgs., 18 Jan., 1 Mar. 1944; min., MM&D staff mtg., 8 Mar. 1944.

29. See memo for CG AAF from Brig. Gen. B. E. Meyers, 25 Mar. 1943.

30. Min., Aircraft Production Bd. mtgs., 23 May, 13 Nov. 1944; Annual Rpt., Office of Legislative Services, Investigations Div., Feb. 1944–Feb. 1945; Lilley, pp. 59–63; IOM, Brig. Gen. Wolfe to CG Mat. Comd., 26 Jan. 1943; ltr., Arnold to Donald Douglas, Douglas Aircraft Co., 16 Oct. 1942; *Wall Street Journal*, 21 Aug. 1943, p. 2; telephone conversations between Sen. Harley M. Kilgore (West Va.) and Robert A. Lovett, 18 Aug. 1943; Merrill C. Meigs, WPB and Col. Aaron E. Jones, Mat. Comd., 25 May 1942; IOM, Maj. John H. Williams and 1st Lt. John A. Hammond to C/Prod. Control Sec., Prod. Div., Mat. Comd., 7 Jan. 1942.

31. Lilley, p. 72; *Wall Street Journal*, 9 Sept. 1940, p. 7; memo for C/MD from Arnold, 21 Oct. 1940.

32. Memo for Admin. of Export Control from Gen. Brett, 11 Oct. 1940.

33. Notes on Aircraft Situation for the Calendar Year 1940, n.s. but probably Lt. Col. A. J. Lyon, 30 Dec. 1940; memo for Mr. Knudsen from Patterson, 4 Apr. 1941; memo for Harold A. Talbott, D/Aircraft Div., WPB from George C. Brainard, D/Tools Div., WPB, 7 Sept. 1942; memo for Mr. Lovett from Arnold, 13 Feb. 1941; ltr., J. H. Kindelberger, Pres., North American Avn. Corp. to Brig. Gen. B. E. Meyers, 12 Feb. 1943; R&R, Arnold to Echols, 13 Mar. 1944; memo for AS/WA from Gen. Meyers, 1 Mar. 1943; IOM, Maj. V. J. Harrington to C/Prod. Control Sec., Prod. Div., Mat. Comd., 8 July 1942; ltr., H. M. Shealey, Factory Supt., Glenn L. Martin Co., Omaha, to Robert A. Lovett, AS/WA, 2 Mar. 1942.

34. Memo for C/AC from Brig. Gen. H. K. Rutherford, D/Planning Br., OUS/W, 13 Dec. 1940; memo for Mr. Lovett from Arnold, 13 Feb. 1941; memo for Mr. Knudsen from Robert P. Patterson, OUS/W, 4 Apr. 1941; Robert H. Connery, *The Navy and the Industrial Mobilization in World War II* (Princeton, 1951), pp. 167–69.

35. Ltr., Maj. Myron R. Wood, OASW to Maj. A. J. Lyon, MD, Wright Fld., 14 Sept. 1939; Charles M. Wiltse, Aluminum Policies of the War Production Board and Predecessor Agencies, May 1940 to November 1945 (Civ. Prod. Admin., 1946), pp. 2–15; Hq. Mat. Comd., Light Metals and Other Critical Aircraft Materials, Aug. 1944, Pt. I, pp. 57–80.

36. Wiltse, pp. 22–31; memo for Col. Spalding from Maj. Myron R. Wood, 27 Aug. 1940; Wkly. Rpt. of MD, 4 Sept. 1940; *New York Times*, 2 Apr. 1941; memo for C/S from Brett, 23 Jan. 1941.

37. Wiltse, *passim;* ltr., Roosevelt to Frank Knox, S/N, 2 Jan. 1942; ltr., Lovett to Harry Hopkins, 24 Jan. 1942.

38. Ltr., Lovett to Hopkins, 18 Mar. 1942; *New York Times*, 18 May 1942, p. 5; *Wall Street Journal*, 13 Aug. 1942, p. 5.

39. Wiltse, pp. 121–65; memo for CG AAF from Gen. Meyers, 25 Mar. 1943; memo for US/W from Lovett, 20 Mar. 1943; min., Aircraft Production Bd. mtg., 19 Apr. 1943.

40. Wiltse, pp. 225–61; ltr., Brig. Gen. E. S. Perrin to Sen. Kenneth Wherry (Neb.), 10 Dec. 1943; Hq. Mat. Comd., Light Metals and Other Critical Aircraft Materials, Pt. I, pp. 136–37.

41. Wiltse, pp. 261–300; statement by Dr. Albert E. Lombard to Alfred Goldberg, 8 May 1952.

42. Wiltse, pp. 299–321; memo for C/AS from Brig. Gen. E. M. Powers, DAC/AS M&S, 15 Feb. 1945.

43. U.S. Dept. of Labor, Bulletin No. 800, pp. 4–5; Modley, *Aviation Facts and Figures*, p. 19; DAR, AC/AS-4, 27 Sept. 1945.

44. Hq. ATSC, Hist. AAF Activities During World War II in the Field of Industrial Manpower [hereinafter cited as Hist. AAF Activities], 1946, pp. 35, 45–52, 59 ff.; Lilley, pp. 75–77; memo for Members of Avn. Prod. Bd. from T. P. Wright, 17 June 1944.

45. Hist. AAF Activities, pp. 34–35, 114–32; R&R, Brig. Gen. L. S. Kuter,

DC/AS to Mat. Comd., 6 Oct. 1942; memo for Mordecai Ezekiel, Joint Aircraft Planning Com., WPB from Thomas C. Blaisdell, Jr., 27 Oct. 1942.

46. U.S. Dept. of Labor, Bulletin No. 800, pp. 12–18; Hist. AAF Activities, pp. 222–28.

47. U.S. Dept. of Labor, Bulletin No. 800, pp. 18–19; Hist. AAF Activities, chaps. VII and VIII.

48. U.S. Dept. of Labor, Bulletin No. 800, pp. 22–25.

49. Official Munitions Production of the United States, pp. 1–59, 70.

50. Ltr., Col. Ira C. Eaker, CO 20th Pursuit Gp. to CG GHQ AF, 23 May 1941; R&R, Mat. Comd. to C/AS, 18 Mar. 1942; Comment #2, R&R, MD to Plans Div., 13 May 1941.

51. Ltr., Harris to Arnold, 30 Aug. 1941.

52. Memo for C/AC from Arnold, 2 Sept. 1941. See also diary for C/AC, by Lt. Col. G. E. Stratemeyer, 9 July 1941; memo for S/W from Gen. Marshall, 29 Aug. 1941; memo for Spaatz from Arnold, 3 Aug. 1941; memo for C/AC from Spaatz, 8 Aug. 1941.

53. Ltr., S/W (sgd. Maj. H. K. Loughry, Bud. Off. for WD) to C/AC, 7 Feb. 1941; diary for C/AC by Col. Stratemeyer, 9 July 1941; memo for C/AS from Brig. Gen. B. E. Meyers, Exec. Mat. Comd., 22 May 1942; R&R, Brig. Gen. T. J. Hanley, DC/AS to Hq. ASC, 31 Dec. 1942.

54. Memo for CG AAF from Maj. Gen. Virgil L. Peterson, TIG USA, 3 Mar. 1942; memo for C/AC from Mat. Comd., 18 Mar. 1942; memo for CG ASC from Col. T. J. Hanley, AC/AS A-4, 18 Apr. 1942; ltr., C/Fld. Services, ASC to CG ASC, 14 May 1942; memo for Gen. Fairchild from Col. L. P. Whitten, D/Base Services, 8 May 1942; memo for C/AS from Brig. Gen. B. E. Meyers, 22 May 1942; draft memo for CG Mat. Comd. from CG AAF, 13 July 1942; IOM, Brig. Gen. K. B. Wolfe, C/Prod. Div., Mat. Comd. to CG AAF, 15 July 1942; memo for AS/WA from Gen. Meyers, 2 Aug. 1942; min., D/MR staff mtg., 3 July 1942; Bureau of the Budget Assistance to the Mat. Comd. Purchasing Sec., 23 Mar. 1942.

55. Min., D/MR staff mtg., 10 July 1942; memo for D/MR from Brig. Gen. T. J. Hanley, Jr., AC/AS A-4, 3 Oct. 1942; memo for D/MR from Col. Richard H. Ballard, AC/AS A-4, 19 Nov. 1942.

56. Min., Avn. Prod. Bd. mtg., 15 Feb. 1943; memo for C/AS from Gen. Echols, 11 Aug. 1943; ltr., Brig. Gen. B. E. Meyers to Maj. Gen. Clements McMullen, Hq. ASC, 13 Sept. 1943; memo for TAI from Col. W. F. Volandt, 20 Sept. 1943; ltr., Brig. Gen. B. E. Meyers to CG Mat. Comd., 2 Oct. 1943; memo for C/AS from AC/AS MM&D, 14 Sept. 1943.

57. Min., M&S staff mtg., 7 Dec. 1944; DAR, M&S, 10 Aug. 1944; memo for Gen. Arnold from Lt. Gen. B. E. Giles, 10 Nov. 1944.

58. Official Munitions Production of the United States, p. 1; USSBS, The Japanese Aircraft Industry, May 1947, p. 155; USSBS, Strategic Bombing of the German Aircraft Industry, Nov. 1945, fig. VI-1 (following p. 93); Modley, *Aviation Facts and Figures*, p. 8; Central Stat. Office, HMSO, *Statistical Digest of the War* (London, 1951), p. 152.

59. Official Munitions Production of the United States, p. 1; USSBS, The Japanese Aircraft Industry, p. 28; USSBS, Strategic Bombing of the German Aircraft Industry, exh. VI-B; *Stat. Digest of the War*, pp. 152–53.

60. USSBS, Strategic Bombing of the German Aircraft Industry, figs. VI-1 and VI-6, exh. VI-B; USSBS, Japanese Aircraft Industry, p. 166, fig. III-1, p. 167, fig. III-2; Lilley *et al.*, *Problems*, p. 90.

61. Official Munitions Production of the United States, p. 1.

62. Memo for US/W from Brig. Gen. B. E. Meyers, C/S Mat. Comd., 22 Jan. 1943; State Dept., Rpt. on War Aid Furnished by the United States to the USSR, 28 Nov. 1945; The United States Army in World War II, Statistics, Lend-Lease (draft), OCMH, pp. 33–34; MD, Consolidated Stat. Rpt., Sec. 1, Pt. 9, Feb. 1941.

63. Official Munitions Production of the United States, pp. 1, 59; AAF Stat. Digest, p. 127.

64. Official Munitions Production of the United States, p. 339.

65. *Ibid.*, pp. 1, 3–5, 13, 18, 29.

66. *Ibid.*, p. 7.

67. *Ibid.*, p. 59.
68. *Ibid.*, pp. 71–72.
69. *Ibid.*, pp. 7–17.
70. *Ibid.*, pp. 18–22.
71. *Ibid.*, pp. 33–52.
72. *Ibid.*, pp. 43–44.
73. Lilley, p. 35.
74. Official Munitions Production of the United States, pp. 61–68.
75. Lilley, pp. 33–34, 102.
76. Official Munitions Production of the United States, pp. 73–78.
77. Lilley, p. 16; Official Munitions Production of the United States, pp. 7–16; AAF Stat. Digest, pp. 119–20; C/Engr. Div., ATSC, Rpt. No. TSEST-A7, Army Aircraft Model Designations, 1 June 1946.
78. AAF Stat. Digest, p. 112; Official Munitions Production of the United States, p. 1.
79. Official Munitions Production of the United States, p. 3; AAF Stat. Digest, p. 112.
80. Official Munitions Production of the United States, p. 1; AAF Stat. Digest, p. 125.
81. AAF Stat. Digest, p. 113; Official Munitions Production of the United States, p. 3.
82. Official Munitions Production of the United States, pp. 1, 3.
83. AAF Stat. Digest, p. 134.
84. *Ibid.*
85. R&R, Hq. AMC to Hq. AAF, 7 Apr. 1942; DAR's, MM&D, 6 Mar. 1944, 7 Apr. 1945; U.S. Dept. of Labor, Bulletin No. 800, p. 23.

NOTES TO CHAPTER 11

1. History of the Army Air Forces Air Service Command, 1921–1944, Aug. 1945, pp. 2–23 [hereinafter cited Hist. ASC].
2. *Ibid.*, pp. 24–25.
3. AR 95-5, 8 June 1940.
4. Memo for C/S from Andrews, 2 Nov. 1935.
5. Hist. ASC, pp. 26–28.
6. R&R, Col. Spaatz, C/Plans Div. to MD, 5 Dec. 1940; ltr., Spaatz to Gen. Andrews, 21 Jan. 1941; ltr., Lt. Gen. Delos C. Emmons, CG GHQ AF to C/AC, 27 Jan. 1941; ltr., TAG to CG GHQ AF, etc., 29 Apr. 1941.
7. Hist. ASC, pp. 35–36.
8. *Ibid.*, pp. 36–38, 41–42; min., 15 July 1941 mtg. Air Council, 16 July 1941; ltr., TAG to C/AC, 28 June 1941.
9. AR 95-5, 12 June 1941; memo for Arnold from C/AS, 19 Aug. 1941; draft AFR, 4 Sept. 1941; 1st ind. (ltr., C/AAF to CG AFCC, 10 Sept. 1941), CG AFCC to C/AAF, 29 Sept. 1941.
10. AAF Reg. 20-4, 17 Oct. 1941; AAF Hq. staff mtg., 6 Oct. 1941; OCAC staff mtg., 30 Oct. 1941, p. 1.
11. Hist. ASC, pp. 53, 57–58.
12. WD Cir. 109, 2 Mar. 1942.
13. Hist. ASC, pp. 58–60, 110–12.
14. AHS-51, The Maintenance of Army Aircraft in the United States, 1939–1945 (General Development and Policies), pp. 29–34.
15. *Ibid.*, pp. 33–39.
16. *Ibid.*, pp. 39–48, 53.
17. Hq. AMC, AAF Supply of Overseas Air Forces, 1946, pp. 5–6; Chester Wardlow, *The Transportation Corps: Responsibilities, Organization, and Operations* (Washington, 1951), pp. 95–106; memo for Brig. Gen. William E. Farthing from Brig. Gen. Clements McMullen, Asst. C/ASC, 5 Nov. 1942.
18. AAF Supply of the Overseas Air Forces, pp. 5–9.
19. For a full account of this subject, see Hq. ATSC, The Organization and Training of Tactical Service Units for Overseas Air Forces, 1935–1945.
20. Ltr., Lt. Gen. M. F. Harmon, CG USAFISPA to Lt. Gen. McNarney, DC/S USA, 29 Apr. 1943; 5th ind. (UR 43-26 from 44th SV Sq., 22 July 1943), Brig. Gen. E. Eubank, Exec. D/AAF Bd., AAFSAT to CG AAF, 23 Oct. 1944. See also discussions of logistics in overseas theaters in Vols. II–V of this series, particularly chaps. 18 and 19 of Vol. II.
21. See previous volumes of this series, particularly chaps. 5 and 16 of Vol. III.
22. Hq. ATSC, History of the Army Air Forces Air Technical Service Command, 1944, pp. 75–78 [hereinafter cited Hist. ATSC].
23. Hist. ASC, pp. 64–66.
24. Hist. ATSC, 1944, pp. 78–88.
25. *Ibid.*, pp. 89–97; memo, Relationship Between the Materiel Command and Air Service Command, sgd. H.B.V., 29 May 1942; memo for Gen. Arnold from Gen. R. E. Wood, 19 Feb. 1943; memo for C/AS from Gen. Arnold, 3 Mar. 1943.

26. Hist. ATSC, 1944, pp. 97–105; M&S staff mtg., 22 July 1944.

27. For expressions of these differing attitudes, see note for Gen. Fairchild from Col. H. W. Bowman, 4 Aug. 1942; D/MR staff mtg., 25 Aug. 1942; Diary of Brig. Gen. L. S. Kuter, Sept. 1942; memo for Gen. W. E. Farthing from Lt. Col. W. F. Nicholson, 6 Jan 1943; memo for DC/S from Maj. Gen. W. D. Styer, Actg. CG ASF, 1 Dec. 1943.

28. John D. Millett, *Organization and Role of the Army Service Forces,* U.S. Army in World War II (Washington, 1954), chap. VIII; ltr., S/W to CG's AAF and ASF, 22 Sept. 1944.

29. Millett, *Army Service Forces,* chap. VIII; Hist. ASC, pp. 71–77.

30. AHS-28, Development of Administrative Planning and Control in the AAF, pp. 75–84; AAF Stat. Digest, pp. 19–20.

31. Hq. ATSC, Estimating Requirements for AAF Equipment, Supplies, and Spare Parts, Dec. 1945, Pt. I, pp. iv, xii, and xiii [hereinafter cited Estimating Requirements].

32. *Ibid.,* pp. 21–22, 89–92, 159–63; ltr., Gen. Frank, CG ASC to CG AAF, 3 May 1943.

33. Estimating Requirements, Pt. II, pp. ix–x, 2–5.

34. Ltr., Brig. Gen. J. W. Jones, TAI to CG AAF, 1 Sept. 1943; Hq. AMC, The Evolution of the Storage System of the Air Technical Service Command, June 1946, Pt. II, pp. 86–91 [hereinafter cited Evolution of the Storage System]; Diary of D/MR, 10 May 1942.

35. Estimating Requirements, Pt. II, pp. 5, 84–85, 104–10.

36. *Ibid.,* pp. 150–61.

37. Hq. ATSC, Supply of AAF Organizational Equipment to the Army Air Forces, Apr. 1945, pp. 3–4 [hereinafter cited Organizational Equipment].

38. Evolution of the Storage System, pp. 83–129.

39. *Ibid.,* pp. 59–82.

40. *Ibid.,* pp. 216, 269–71; Hq. ATSC, History of the Acquisition of Facilities for the Air Service Command, 1945, pp. 162–63; memo for DC/S USA from Gen. Peterson, TIG, 12 Aug. 1944.

41. Evolution of the Storage System, Pt. II, pp. 215–77; ltr., Gen. Jones, AI to CG AAF, 1 Sept. 1943.

42. Hist. ATSC, 1944, app. III.

43. Organizational Equipment, p. 59.

44. *Ibid.,* pp. 31–34.

45. *Ibid.,* pp. 34–49.

46. *Ibid.,* pp. 49–56.

47. R&R, Gen. Arnold to all Air Staff Divs., 22 Feb. 1943.

48. AAF Supply of the Overseas Air Forces, pp. 16–19; R&R, Gen. Meyers to AC/AS Plans, 27 Jan. 1944.

49. Memo for Brig. Gen. Whitten from Col. C. B. Stone, III, 1 May 1943; R&R Gen. Kuter to Brig. Gen. Jamison, 20 Dec. 1943; AAF Supply of the Overseas Air Forces, pp. 19–22.

50. Memo for Gen. Whitten from Col. Stone, 1 May 1943; AAF Supply of the Overseas Air Forces, pp. 22–25; AAF Reg. 65-12, 11 Oct. 1943.

51. Memo for CG AAF, etc. from Lt. Gen. McNarney, DC/S USA, 1 Jan. 1944; R&R, Gen. Kuter to Gen. Jamison, 20 Dec. 1943.

52. DAR, Air Services Div., AC/AS M&S, 21 Nov. 1944; Evolution of the Storage System, p. 284; AAF Supply of the Overseas Air Forces, pp. 71–74.

53. AAF Supply of the Overseas Air Forces, pp. 72–76.

54. AAF Stat. Digest, pp. 212–13. On the Transportation Corps, see Wardlow's volume cited in n. 17.

55. R&R, Comment No. 3, Gen. Whitten to AC/AS A-4, 22 Mar. 1943; ltr., Gen. Frank to CG AAF, 16 Feb. 1943.

56. AHS-51, pp. 4–5; Hist. ASC, pp. 24–25.

57. AHS-51, p. 7; OCAC, Résumé of division chiefs mtg., 7 Aug. 1939.

58. R&R, Gen. Spaatz, C/Plans Div. to Exec. OCAC, 2 Jan. 1941; Diary, C/AS, 23 July 1941; memo for Spaatz from Arnold, 3 Aug. 1941; min., mtg. in General Arnold's office on 9 Dec. 1941.

59. R&R, Gen. Spaatz, C/Plans Div. to Exec. OCAC, 2 Jan. 1941; AHS-51, p. 24; Hq. AAF staff mtg., 1 Dec. 1941; ltr., Gen. Frank, CG ASC to CG AAF, 3 May 1943.

60. AHS-51, pp. 24–28.

61. *Ibid.,* pp. 29–55.

62. Diary of D/MR, 12 May 1942.

63. See Hq. AMC, The Development of AAF Maintenance and Servicing Equipment for Theaters of Operations, 1941–1945.

64. Hq. ATSC, A History of the Army

Aircraft Repair Ship Project, Nov. 1943–Sept. 1944.

65. AHS-51, pp. 56–58, 61–65. For a full discussion of the unsatisfactory report system, see Hq. ATSC, A History of the Operation of the Unsatisfactory Report in the Army Air Forces, 1939–1945.

66. AHS-51, pp. 58-61, 63–68.

67. *Ibid.*, pp. 68–77.

68. *Ibid.*, pp. 78-79; R&R, Arnold to Giles, 10 Nov. 1944; Bd. to meet on 9 Aug. or as soon thereafter as possible, n.d., n.s., but Aug. 1944, from Arnold or Giles. See also previous volumes of this series, particularly Vol. III, 590–91.

69. AHS-51, pp. 79–80.

70. *Ibid.;* BADA, ASC UUSTAF Monthly Stat. Sum., June 1944, p. 9; R&R, Arnold to Giles, 10 Nov. 1944; Bd. . . . , cited in n. 68.

71. Memo for Gen. Spaatz from Gen. Arnold, 3 Aug. 1941; speech by Gen. Echols at Off. Club, Bolling Fld., 2 Apr. 1941; memo for CG AAF from Maj. Gen. Virgil L. Peterson, TIG, 3 Mar. 1942; notebook of Col. L. P. Whitten, D/Base Services, Hq. AAF, 16 Mar. 1942; memo for D/Tech. Inspec. from Col. Edmund W. Hill, TAI, 3 Apr. 1942; memo for CG AAF from Maj. Gen. Thomas T. Handy, AC/S OPD, 23 June 1942; memo for Col. Harper from Maj. J. J. O'Shea, 27 Aug. 1942; Diary of Brig. Gen. L. S. Kuter, 22 Sept. 1942.

72. AHS-51, figs. 13 and 14 (following p. 129); Whitten notebook, cited in n. 71, 12 Mar. 1943; Wkly. Acty. Rpt., ASC, 9 June 1944; memo for CG Continental Air Forces from Arnold, 6 July 1945.

73. AHS-51, p. 123; R&R, Col. J. J. Ladd, C/Troop Basis Div., OC&R to AC/S OPD, 5 Apr. 1945; memo for CG AAF from Gen. Frank, 15 Jan. 1943.

74. Interview by Alfred Goldberg with Maj. Gen. Hugh J. Knerr, 24 Nov. 1947; AHS-51, p. 137; see n. 19, Pt. II, pp. 130–46.

75. AHS-51, pp. 88–91.

76. *Ibid.*, figs. 13 and 14.

77. Memo for S/W from Arnold, 20 Jan. 1944.

78. Stat. Sum. 9th AF Opns., 16 Oct. 1943–8 May 1945, p. 8.

79. AAF Stat. Digest, pp. 136–53.

NOTES TO CHAPTER 12

1. Memo for C/S from Arnold, 23 July 1940; memo for W. S. Knudsen from AS/W, 10 Aug. 1940; memo for AS/W from Col. J. H. Burns, Exec., 16 July 1940; NDAC, Airplane Div., Rpt. 3-A, 8 July 1940, pp. 5–9.

2. Memo for Marshall from Arnold, 7 Nov. 1940; memo for Marshall from Brett, 19 Dec. 1940; Notes on the Aircraft Situation for the Calendar Year 1940, n.s. but probably by Lt. Col. A. J. Lyon, Dec. 1940, p. 8.

3. ABC-2, 29 Mar. 1941.

4. *Ibid.*

5. AHS-106, Distribution of Air Materiel to the Allies, 1939–1944: Controls, Procedures, and Policies, pp. 27–30.

6. *Ibid.*, pp. 34–35; msg., Harriman to Roosevelt, 9 Oct. 1941; memo for S/W from Roosevelt, 3 Aug. 1941; JCS 37th Mtg., 13 Oct. 1942.

7. USAF Stat. Digest, 1947, pp. 2, 131; memo for S/W from Lovett, Oct. 1941; memo for Harry Hopkins from Arnold, and incl. thereto, 5 Jan. 1942.

8. Memo for C/S from Arnold, 8 Sept. 1941.

9. Richard M. Leighton and Robert W. Coakley, Logistics of Global Warfare, 1941–1943, pt. 1, chap. III, p. 89, in United States Army in World War II series. To be published.

10. Memo for C/S from Stimson, 9 Dec. 1941; conf. with Gen. Arnold, n.s. but probably Lt. Col. Clayton Bissell, 11 Dec. 1941; memo for AS/W from Brig. Gen. B. E. Meyers, 22 Apr. 1942; ltr., Stimson to the President, 24 Apr. 1942.

11. AHS-106, pp. 38–46; JCS 11th Mtg., 20 Apr. 1942.

12. Memo for Gen. Strong, AC/S OPD from Lt. Col. Thomas T. Handy, 5 June 1940; memo for Lt. Col. S. P. Spalding from Maj. Myron R. Wood, 27 July 1940; memo for US/W from AS/WA, 12 Jan. 1942; memo for Mr. Patterson, US/W from F.D.R., 14 Jan. 1942.

13. Memo for S/W from Roosevelt, 30 Aug. 1941; ltr., President to S/W, 28 Dec. 1941; ltr., Marshall to King, 27 Apr. 1942; memo for C/AS from Gen. Kuter, 28 Apr. 1944; memo for Arnold from KNW (Lt. Col. Kenneth N. Walker), 25 Sept. 1941.

14. Dept. of State Publication 2759, Soviet Supply Protocols, Wartime International Agreements, 1948; State Dept., Rpt. on War Aid Furnished by the United States to the USSR, Nov. 28, 1945.

15. Allocation of Airplanes–1942, sgd. by Arnold and Portal, 13 Jan. 1942; AHS-106, pp. 55–56; memo for Mat. Comd., Defense Aid Sec. (attn.: Lt. Col. H. R. Paige) from Lt. Col. E. C. Langmead, Sec., MAC (Air), 18 Mar. 1942.

16. JCS 4th Mtg., 7 Mar. 1942; 8th Mtg., 30 Mar. 1942; 15th Mtg., 18 May 1942; memo for AC/S OPD from Arnold, 11 Apr. 1942; memo for C/S from Arnold, 9 May 1942.

17. Msg. #147, Roosevelt to Former Naval Person, 19 May 1942.

18. White House conf., 20 May 1942.

19. Arnold-Portal conversations, 26–31 May 1942; memo of agreement between Lt. Gen. Arnold, Rear Adm. Towers, and ACM Portal, 21 June 1942; CCS 30th Mtg., 2 July 1942.

20. Memo for Brig. Gen. O. A. Anderson from Cols. Martin, Langmead, and Harper, 9 Nov. 1942; memo for CG AAF from Gen. Anderson, 16 Nov. 1942.

21. Leighton and Coakley, chap. IX, p. 34 ff.; JCS 178, 25 Dec. 1942; memo for AC/S OPD (attn.: Gen. Wedemeyer) from Maj. Gen. G. E. Stratemeyer, C/AS, 17 Dec. 1942.

22. R&R, Arnold to Brig. Gen. T. J. Hanley, DC/AS, 26 Apr. 1943; memo for the President from Arnold, 30 June 1943.

23. CCS 277, 13 July 1943; ltr., Gen. Meyers to UN Br., ASC, Dayton, Ohio, 26 Aug. 1943.

24. AC/AS Plans Div. Digest, 3 Nov. 1943; ltr., Arnold to the President, 5 Nov. 1943.

25. JCS 724, 23 Feb. 1944; memo for Gen. Giles from Brig. Gen. W. E. Hall, DC/AS, 21 Feb. 1944.

26. Memo for C/AS from AC/AS Plans, 28 Apr. 1944.

27. R&R, AC/AS Plans to AC/AS MM&D, 11 May 1944; JCS 771 series, 1944.

28. CCS 495/7, 30 July 1944.

29. JCS 724/2, 28 Nov. 1944; CCS 495/12, 15 Dec. 1943; JCS 724/3, 3 Feb. 1945.

30. Incl. to memo for C/S from Gen. Giles, 5 Feb. 1945; DAR, MD, M&S, 27 Apr. 1945; JCS 774/4, 5 June 1945; JCS 777/11, 10 July 1945.

31. ADO 302 [Aircraft Distribution Office, AC/AS M&S]; ADO, RM-80D.

32. AAF Stat. Digest, p. 127.

33. R&R, Col. Spaatz to Exec. OCAC, 5 Apr. 1940; ltr., Col. C. W. Russell, C/S GHQ AF to C/AC, 16 Aug. 1940 and 2d ind. thereto, Brig. Gen. B. K. Yount, C/Plans Div., OCAC to T&O Div., 30 Aug. 1940.

34. See AAF Central Files, 452.1 Allocations.

35. *Ibid.;* min., mtg. in Gen. Arnold's office on 9 Dec. 1941.

36. AAF Central Files, 452.1 Allocations; Organizational and Functional Hist. of A-3 in AAF Hq., 1939–1945, pp. 62–83.

37. AAF Central Files, 452.1 Allocations.

38. AAF Stat. Digest, p. 127.

39. *Ibid.*, pp. 302–3.

40. R&R, Lt. Col. W. E. Farthing to Col. C. Spaatz, Plans Div., 1 Mar. 1940; ltr., Adm. H. R. Stark, CNO to C/S USA, 5 June 1940.

41. Memo for D/International Div., SOS from CG Mat. Comd., 28 May 1942; AMC, AAF Supply of the Overseas Air Forces, 1946, pp. 202–3, 221–24, 233–34.

42. Memo for CG SOS from Brig. Gen. T. J. Hanley, AC/AS A-4, 28 Aug. 1942, and 2d ind. thereto, Brig. Gen. T. H. Dillon, DC/Trans. to AC/S Mat., Hq. SOS, 10 Sept. 1942; ltr., Col. C. F. Nielson, C/Traffic Div., AC/AS MM&D to CG NYPOE, 12 Apr. 1943; *AAF in WW II*, II, 77.

43. Memo for Brig. Gen. J. R. Deane, Sec. JCS, from Arnold, 9 Jan. 1942; JCS 192, 11 Jan. 1942; JCS mtg., 9 Mar. 1943; JPS 114/1, 23 Feb. 1943; JCS 192/1 (revised), 3 Apr. 1943.

44. Memo for Lt. Col. E. A. Boudreau, Traffic Div., MM&D from Capt. J. F. Schwarz, Export Br., 9 Apr. 1943; ltr., Gen. Meyers to CG, ASC, 5 May 1943; memo for DC/AS from Gen. Meyers, 7 May 1943; memo for Gen. Somervell from Gen. Hanley, 8 May 1943; AAF Supply of the Overseas Air Forces, pp. 208–10.

45. AAF Supply of the Overseas Air Forces, *passim;* Hist. 356th Ftr. Gp.,

July, Aug., Sept., 1943; Hist. Ferrying Div., ATC, 15 Feb. 1943–13 Oct. 1943, pp. 207, 225–26.

46. AAF Supply of the Overseas Air Forces, pp. 212–13; JCS 192/1 (revised), 3 Apr. 1942.

47. AAF Supply of the Overseas Air Forces, pp. 197–201, 213–14.

48. Daily Diary, AC/AS MM&D, 17 Jan. 1944; AAF Supply of Overseas Air Forces, exh. 40, opp. p. 270.

49. AAF Supply of Overseas Air Forces, pp. 215–16; Wkly. Acty. Rpt., MM&D, 29 Apr. 1944; memo for C/AS from Gen. Echols, 6 Apr. 1944.

50. Lt. Col. L. W. Hartman, Traffic Div., MM&D, Conversion of Vessels for Transportation of Aircraft (mtg. with Trans. Corps), 21 July 1943; DAR's, MM&D, 15 Jan., 4 Feb. 1944.

51. AAF Supply of the Overseas Air Forces, pp. 217–21, 270, exh. 40.

52. *Ibid.*, p. 232 ff.

53. Cable WAR H 5216, Gen. Knerr, CG VIII AFSC to Gen. Frank, CG ASC, 31 Jan. 1944; ltr., Brig. Gen. C. B. Stone, III, C/S EAC to Col. Nicholson, Hq. AAF, 26 Feb. 1944.

54. AAF Supply of the Overseas Air Forces, pp. 248–52.

55. *Ibid.*, p. 235.

56. AAF Stat. Digest, p. 135.

57. *Ibid.*, pp. 136–39; memo for S/W from Robert A. Lovett, AS/WA, Oct. 1941; memo for Harry Hopkins from Arnold, 5 Jan. 1942.

58. AAF Stat. Digest, p. 153.

59. AAF Stat. Digest, pp. 3–7; USAF Stat. Digest, 1947, pp. 2–3.

60. AAF Stat. Digest, pp. 6–8.

NOTES TO CHAPTER 13

1. AHS-16, Legislation Relating to the AAF Personnel Program, 1939–1945 (rev. ed.), p. 3; AAF Stat. Digest, p. 15.

2. AAF Stat. Digest, pp. 15–16.

3. AHS-2, Initial Selection of Candidates for Pilot, Bombardier, and Navigator Training, p. 7.

4. R&R, Spaatz to C/AC, 8 Sept. 1939.

5. *Ibid.;* ltr., Sec. of War to Rep. Carl Vinson, 5 July 1941.

6. Memo from Spaatz to Arnold, 8 Sept. 1939.

7. This question is discussed from the point of view of the adverse effect upon the AGF in R. R. Palmer, Bell I. Wiley, and W. R. Keast, *The Procurement and Training of Ground Combat Troops* (Washington, 1948), pp. 1–28.

8. AHS-39, Legislation Relating to the Air Corps Personnel and Training Programs, 1907–1939, pp. 40–43; AHS-15, Procurement of Aircrew Trainees, pp. 8–9.

9. Memo from Arnold for Brig. Gen. F. M. Andrews, 1 June 1940.

10. Memo for AC/S, G-3 from Brett, Actg. C/AC, 11 July 1940.

11. Memo for Marshall from Arnold, 19 June 1940; memo for AC/S, G-3 from Arnold, 23 June 1940.

12. AHS-15, pp. 8–9.

13. Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations* (Washington, 1950), pp. 321–52.

14. *Ibid.*, p. 344.

15. AWPD/1, Munitions Requirements of the AAF to Defeat Our Potential Enemies, 11 September 1941.

16. *Ibid.*, Tabs. 15 and 16.

17. AHS-15, pp. 9–10.

18. AHS-5, Individual Training of Bombardiers, p. 2; AHS-27, Individual Training of Navigators in the AAF, pp. 1–5.

19. AHS-16, pp. 36–39.

20. AHS-7, Legislation Relating to the Army Air Forces Training Program, 1939–1945 (rev. ed.), pp. 50–58; AHS-39, pp. 57–63; AHS-21, Aviation Cadet Ground Duty Program: Policy, Procurement, and Assignment, pp. 19–20, 25.

21. AHS-2, pp. 12–17, and table VI, p. 20.

22. *Ibid.*, pp. 7–10, 19–21.

23. AHS-15, pp. 14–16; AHS-2, p. 10.

24. 1st ind. (C/AC to C/S, 24 May 1940), TAG to C/AC, 6 June 1940.

25. Quoted in AHS-16, p. 12.

26. AHS-16, p. 41. Early in July 1941 the commanding general of the Gulf Coast Training Center wrote a strong recommendation against the training of enlisted pilots. He urged deferment until absolutely necessary to fill quotas and justified his stand by saying: "We have at present a number of enlisted pilots in the Air Corps. They are neither fish nor fowl—no commanding officer at any Air Corps station has ever been able to

fit them properly into the pattern of life of the Air Corps. Until the formation of transport squadrons for freight carrying, there was little use for them and they were a most unhappy lot" (quoted in Hist. CFTC, 7 Dec. 1941–31 Dec. 1942, III, 272).

27. AHS-15, pp. 16–19; AHS-16, pp. 39–42.
28. AHS-21, p. 26.
29. AHS-7, pp. 68–73; AHS-15, pp. 19–20; AHS-16, pp. 13–14.
30. AHS-15, pp. 20–21.
31. *Ibid.*, pp. 21–22.
32. Hist. CFTC, 7 Dec. 1941–31 Dec. 1942, III, 238–40.
33. *Ibid.*, pp. 241, 247–49.
34. AHS-15, pp. 22–24.
35. R&R, Rush B. Lincoln, C/Plans Sec. to C/Info. Div., 1 Nov. 1937, inclosing rpt. on orgn. of GHQ AF, 27 Oct. 1937.
36. AHS-15, pp. 24–26; Hist. CFTC, 7 Dec. 1941–31 Dec. 1942, III, 243–45; ltr., CG GHQ AF to CG's 1st, 2d, 3d Wgs., GHQ AF, 4 Apr. 1939.
37. AHS-15, pp. 27–30.
38. *Ibid.*, pp. 31–35. For a more detailed evaluation of the composition and accomplishments of the flying cadet examining boards, see Hist. CFTC, 7 Dec. 1941–31 Dec. 1942, III, 247–54.
39. AHS-15, pp. 35–38.
40. *Ibid.*, pp. 38–39.
41. Hist. CFTC, 7 Dec. 1941–31 Dec. 1942, III, 246.
42. AHS-15, pp. 39–41.
43. *Ibid.*, pp. 41–43.
44. *Ibid.*, pp. 43–50.
45. AHS-21, pp. 1–14 (for the Arnold quotation, see p. 10).
46. *Ibid.*, p. 4.
47. *Ibid.*, p. 9.
48. *Ibid.*, p. 17, quoting Col. Carl Spaatz, 8 Jan. 1940; see also R&R, B. K. Yount, Plans Div. to J. E. Fichel, T&O, 3 Sept. 1940.
49. AHS-21, pp. 20–22.
50. Yount R&R cited in n. 36; AHS-21, pp. 22–23.
51. AHS-21, pp. 23, 34.
52. *Ibid.*, p. 60.
53. *Ibid.*, pp. 27–30.
54. *Ibid.*, pp. 23, 34–35, 43–44.
55. *Ibid.*, pp. 61–63.
56. *Ibid.*, pp. 26–27, 67–68, 76–77.
57. *Ibid.*, pp. 63–64.
58. AAF Stat. Digest, pp. 70, 74–75.
59. Memo for AC/S, G-1 from Maj. Gen. F. M. Andrews, AC/S, G-3, 19 Nov. 1940.
60. See memo for Spaatz from Duncan, C/Pers. Div., 30 Jan. 1941.
61. AHS-39, pp. 29–34; ltr. prepared for sgnr. of Gen. Yount to Rep. Stephen Pace, 24 May 1940.
62. AHS-39, p. 41.
63. Public Law No. 18.
64. AHS-39, p. 42.
65. AHS-16, p. 8; TAG to Chiefs of All Arms and Services, 12 June 1939.
66. AHS-16, pp. 48–49; R&R, Yount, Plans Div., to Exec. OCAC, 27 Aug. 1940; memo for TAG from Brig. Gen. W. E. Shedd, AC/S, 15 June 1940.
67. Ltr., Arnold to Sen. Chan Gurney, 18 June 1940.
68. R&R, ICE, Exec. OCAC to Chiefs, Training and Operations, Plans, Personnel Divisions, in turn, 9 Aug. 1940.
69. *Ibid.*
70. Ltr., Spaatz, C/Plans Div., to TAG, 7 Mar. 1941.
71. Ltr., OCAC to TAG, 28 Nov. 1940.
72. AAF Stat. Digest, p. 19.
73. Memo for AC/S, G-1, from Stratemeyer, Exec. OCAC, 10 July 1941.
74. Ltr., C/AAF to C/AC, 27 July 1941.
75. Palmer, Wiley, and Keast, *Procurement and Training of Ground Combat Troops*, p. 93.
76. *Ibid.*
77. AAF Stat. Digest, p. 19.
78. AHS-16, pp. 14–16.
79. TAG to CG's all Armies, Corps, and Corps Areas, 17 Dec. 1940; memo for C/S, GHQ from Col. H. L. Twaddle, Actg. AC/S, 26 Nov. 1940.
80. See *Air Force*, XXIX (June, 1946), p. 34.

NOTES TO CHAPTER 14

1. H. H. Arnold, *Global Mission* (New York, 1949), pp. 180–81; History, AAF Training Command, 1 Jan. 1939–V-J Day, III, 494–95 [hereinafter cited as Hist. AAF Tng. Comd.].
2. Arnold, *Global Mission*, p. 181.
3. Hist. AAF Tng. Comd., I, 8; III, 495–96.

4. Hist. AAF Tech. Tng. Comd., 1 Jan. 1939–7 July 1943, I, 116–17.
5. AHS-7, Legislation Relating to the AAF Training Program, 1939–1945, pp. 12–13.
6. *Ibid.*, p. 15; Hist. AAF Tng. Comd., I, 9.
7. Ltr., C. C. Moseley to Sen. Sheridan Downey, 14 Mar. 1939.
8. Hist. AAF Tng. Comd., III, 495; TAG to Chiefs of All Arms and Services, 12 June 1939.
9. Maj. H. A. DeWeerd, ed., *Selected Speeches and Statements of General of the Army George C. Marshall* (Washington, 1945), p. 52; WD Immediate Release, 22 June 1940.
10. Hist. AAF Tng. Comd., III, 498.
11. *Ibid.*, pp. 496–97, 517–21.
12. *Ibid.*, pp. 497–502.
13. AHS-7, p. 14.
14. Hist. AAF Tng. Comd., III, 509.
15. *Ibid.*, pp. 510–12.
16. WD Immediate Release, 14 June 1940.
17. Hist. AAF Tng. Comd., III, 539–40.
18. *Ibid.*, pp. 522–23, 538–40.
19. *Ibid.*, pp. 505, 541.
20. Report of the Commanding General of the Army Air Forces to the Secretary of War, 4 Jan. 1944, p. 7.
21. Hist. AAF Tng. Comd., III, 544–45.
22. TAG to C/AC, 12 Aug. 1939; Hist. AAF Tech. Tng. Comd., 1 Jan. 1939–7 July 1943, I, 117–18.
23. *Ibid.*, pp. 119–22.
24. *Ibid.*, pp. 123–24, 135.
25. R&R, Tng. and Opns. Div. to Plans Div., 1 June 1940, in Black Book of Correspondence.
26. Hist. AAF Tech. Tng. Comd., 1 Jan. 1939–7 July 1943, I, 132–34, 143.
27. *Ibid.*, pp. 144–47.
28. *Ibid.*, pp. 148–54.
29. C/AC to TAG, 15 June 1940.
30. Hist. AAF Tng. Comd., I, 138–39.
31. *Ibid.*, pp. 67–72.
32. *Ibid.*, p. 9.
33. R&R, B. K. Yount, C/Plans Div. to Col. Wilson, 9 May 1940; memo for C/S from Gen. Arnold, C/AC, 24 May 1940; Arnold, *Global Mission*, pp. 205–6.
34. AHS-53, Organization of AAF Training Activities, 1939–1945, p. 6; Hist. AAF Tng. Comd., I, 96–97.
35. Hist. AAF Tng. Comd., I, 11-23.
36. See WD Immediate Release, 14 June 1940: Training Program for Air Corps Expansion Announced; WD Immediate Release, 22 June 1940: Augmented Pilot Training Program for Air Corps Expansion; and WD, Memorandum for the Press, 22 June 1940: New Locations for Air Corps Units; Arnold, *Global Mission*, pp. 202–3; Mark S. Watson, *Chief of Staff: Prewar Plans and Preparation* (Washington, 1950), pp. 166–82.
37. Hist. AAF Tng. Comd., I, 12–13.
38. AHS-5, Individual Training of Bombardiers, pp. 18–23.
39. *Ibid.*, pp. 35–36.
40. *Ibid.*, pp. 37–38.
41. AHS-27, Individual Training of Navigators in the AAF, pp. 1–4, 43–50.
42. *Ibid.*, pp. 176–80.
43. *Ibid.*, pp. 7–9.
44. *Ibid.*, pp. 10–25.
45. AHS-31, Flexible Gunnery Training in the AAF, pp. 1–6.
46. *Ibid.*, pp. 7–12, 96–104.
47. Hist. AAF Tech. Tng. Comd., 1 Jan. 1939–7 July 1943, I, 69.
48. Hist. AAF Tng. Comd., I, 55–58.
49. Watson, *Chief of Staff*, p. 166 ff.
50. R&R, Tng. and Opns. Div. to Gen. Arnold, 10 June 1940.
51. Hist. AAF Tng. Comd., I, 68–69; AAF Stat. Digest, pp. 72–73.
52. Hist. AAF Tng. Comd., I, 68; ltr., Col. Asa N. Duncan, C/Pers. Div. to C/AC, 30 Jan. 1941.
53. Memo for AC/S G-4 from Col. Robert Olds, Plans Div., OCAC, 31 Mar. 1941; memo for C/S from Lt. Col. M. S. Fairchild, Plans Div., OCAC, 15 May 1941; ltr., TAG to C/AC, 6 June 1941; and see Hist., AC Tech. Tng., 1917, 7 Dec. 1941, Vol. I.
54. Memo for C/S from Arnold, 2 Jan. 1942; TAG to C/AAF, 19 Jan. 1942; memo for A-1 *et al.* from Col. J. Y. York, 5 Feb. 1942; and Hist., AAFTTC and Its Predecessors, 1 Jan. 1939–7 July 1943.
55. AAF Stat. Digest, p. 72; memo for DC/S from Col. Farthing, 5 June 1940.
56. Hist. AAF Tng. Comd., I, 138.
57. AHS-53, p. 8.
58. Tulsa offered a central location with respect to the various technical schools and in General Lincoln's opinion the move had "assisted greatly in

speeding up the program, facilitating as it does, the contacts between the schools, myself, and members of my staff sections." (Ltr., Maj. Gen. Rush B. Lincoln to Maj. Gen. Walter R. Weaver, 20 Jan. 1942.)

59. AHS-53, pp. 13–14.

60. *Ibid.*, pp. 18–20.

61. Memo for C/S from C/AC, 27 June 1941; "A Command is Born," *American Pilot and Aircraftsman*, IV, 10–11.

62. Memo for DC/AS from Actg. C/AC, 23 Dec. 1941.

63. Hist. AAF Tng. Comd., I, 104–7.

64. *Ibid.*, pp. 106–13; interview with Maj. Gen. W. F. Kraus, CG CFTC, 25 May 1944.

65. R&R, C. Spaatz, C/Plans Div. to T&O Div., 18 Mar. 1941, inclosing inspection reports; 4th AF Hist. Study No. I-1, p. 91; Hist. Tng. in 1st AF: Background and Tng. to May 1942, pp. 91–92.

66. Hist. Tng. in 1st AF, pp. 83, 112–18; R&R, as cited in n. 65.

67. Memo for Plans Sec. from R. M. Webster, sub: Information and Directive for GHQ Air Force–Expansion Program, 14 Apr. 1939.

68. 4th AF Hist. Study No. I-1, pp. 33, 90.

69. *Ibid.*, 91; I Ftr. Comd., Rpt. of Tng. Conf., Mitchel Fld., N.Y., 22 Oct. 1945.

70. 4th AF Hist. Study No. I-1, pp. 77, 290–93.

71. Arnold, *Global Mission*, pp. 168–69, 187–89.

72. Report of the Commanding General of the Army Air Forces to the Secretary of War, 4 Jan. 1944, p. 7.

73. AHS-10, Organization of the Army Air Arm, 1935–1945 (revised), p. 36, and chart, p. 138; memo for C/AC from Col. G. E. Stratemeyer, Actg. C/Plans Div., 23 Oct. 1940.

74. Hist. AAF Tng. Comd., V, 978–1019.

75. *Ibid.*, III, 585–604.

76. See talk made by Major Brandt at Staff Meeting, 10 Sept. 1941, on British use of the B-17, in min. OCAC staff mtgs., June–Dec. 1941.

77. Copy of this Report is in AFSHO files, Accession No. 1248-9 A.

78. Hist. Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, Pt. I, 1935–1942, pp. 49–51; Hist. Tng. in the 1st AF: 1941 Maneuvers and the AAF, pp. 8–9.

79. Hist. Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, Pt. I, pp. 51–63.

80. *Ibid.*, pp. 66–75.

81. *Ibid.*, pp. 65–66; Hist. Tng. in the 1st AF: 1941 Maneuvers and the AAF, 76–80; Watson, *Chief of Staff*, pp. 239–40.

82. See Watson, *Chief of Staff*, pp. 278–98, and Arnold, *Global Mission*, for discussion of the movement to attain air autonomy.

83. DeWeerd, *Speeches and Statements of Marshall*, p. 110, contains the quotation from the Chief of Staff's statement before the Truman committee, 22 Apr. 1941.

84. AAF Stat. Digest, pp. 3, 16.

85. Report of the Commanding General of the Army Air Forces to the Secretary of War, 4 Jan. 1944, pp. 2, 11.

86. AAF Stat. Digest, pp. 64, 72.

87. Report of the Commanding General of the Army Air Forces to the Secretary of War, 4 Jan. 1944, p. 14.

88. Radg., Arnold to Spaatz, 7 Dec. 1941.

89. Ltr., Brig. Gen. G. E. Stratemeyer to CG Southeast Air Corps Training Center, 31 Dec. 1941, quoted in Hist. EFTC, Installment II, vol. I, 82.

90. Hist. AAF Tng. Comd., I, 14–15, 68–69.

91. *Ibid.*, 29–30.

92. *Ibid.*, 34.

93. Hist. EFTC, Installment II, Vol. I, 264.

94. Report of the Commanding General of the Army Air Forces to the Secretary of War, 4 Jan. 1944, p. 13.

NOTES TO CHAPTER 15

1. For a detailed account of the problems involved in selection, classification, and assignment of bombardier and navigator trainees, see draft monograph, AAF Classification Centers (Aircrew), 1 Jan. 1939 to 31 May 1944.

2. Interview with Brig. Gen. Charles R. Glenn, Surgeon, AAF Tng. Comd., 5 Dec. 1943; Col. John C. Flanagan, ed., The Aviation Psychology Program in

the Army Air Forces: Report No. 1, prepared by Staff, Psych. Sec., Hq. AAF (Washington, D.C.), 30 June 1946, pp. 5, 21.

3. R&R, Med. Div. to Exec. OCAC thru Mil. Pers. and T&O Divs., 19 Nov. 1941.

4. R&R, C/AS to A-1 AAF, 15 Nov. 1941.

5. R&R, C/Tng. Div. to C/AC, 3 Dec. 1941.

6. Flanagan rpt. cited in n. 2, pp. 12–13.

7. Glenn interview cited in n. 2.

8. Memo for Brig. Gen. Carl Spaatz from Brig. Gen. G. E. Stratemeyer, 12 Dec. 1941; memo for C/AC from AC/AS A-1, 19 Dec. 1941.

9. Annual Rpt. Psych. Div., Hq. AAF, 1942, p. 3; TWX, Weaver, Actg. C/AC to CG SEACTC, 29 Dec. 1941.

10. Authorities differ on whether the quota system was in effect during this period. The author of AAF Historical Study No. 15, Procurement of Aircrew Trainees, pp. 57–58, declares that each examining board had a quota, that the quotas were established by TAG, sent to corps area headquarters, and then prorated to individual boards. The historical officer for the Central Flying Training Command declares that quotas were removed on 13 December 1941 and were not restored until early in March 1942, and that aviation cadet recruiting was removed from corps area control on 7 January 1942 and was not restored until 29 March 1942. (See Hist. CFTC, Installment II, Vol. III, 256–62.) The situation at the training centers would lead one to conclude that if quotas were in effect they certainly were administered in a loose fashion.

11. Hist. EFTC, 1941–42, I, 343–45; Hist. CFTC, 1941–42, III, 292–99; Unit Hist. Clas. Sec., Santa Ana AAB, 1942, pp. 1–2; TWX, Cousins, WCACTC to ACFTC, 19 Mar. 1942.

12. Hist. EFTC, 1941–42, I, 344, citing telephone conversation between Col. Witsell, TAG at Maxwell Fld., and Col. Clifford, Hq. AAF.

13. AHS-15, Procurement of Aircrew Trainees, pp. 60–61; Hist. CFTC, 1941–42, III, 263–64.

14. Hist. EFTC, 1941–42, I, 82–96.

15. AHS-15, pp. 57–59.

16. *Ibid.*, 54–55; Hist. CFTC, 1941–42, III, 261.

17. AHS-15, pp. 60–66.

18. *Ibid.*, p. 66; AHS-21, The Aviation Cadet Ground Duty Program, p. 55.

19. Hist. CFTC, 1941–42, III, 264–67; AHS-15, pp. 66–70.

20. AHS-15, pp. 70–75.

21. AHS-21, pp. 43–46.

22. *Ibid.*, pp. 55–57, 81.

23. *Ibid.*, pp. 58–66.

24. *Ibid.*, pp. 66–69.

25. *Ibid.*, pp. 70–76.

26. *Ibid.*, pp. 77–78, 84.

27. *Ibid.*, p. 83.

28. *Ibid.*, p. 87.

29. Procurement and Training of Air Service Command Civilian Personnel, Pt. I, 1939 thru 1941, pp. 1–6.

30. *Ibid.*, pp. 10–13, 28–29.

31. *Ibid.*, pp. 22–27.

32. *Ibid.*, chart between pp. 3 and 4.

33. *Ibid.*, p. 77.

34. *Ibid.*, Pt. II, 1942, p. 2.

35. *Ibid.*, Pt. I, pp. 5–6, and Pt. II, pp. 4–5.

36. *Ibid.*, Pt. II, pp. 6–20.

37. *Ibid.*, pp. 21–26.

38. *Ibid.*, Pt. III, 1943 thru 1944, pp. 77–81.

39. *Ibid.*, pp. 82–96.

40. *Ibid.*, Pt. II, pp. 29–39.

41. *Ibid.*, Pt. III, pp. 135–36 and Figure 11.

42. *Ibid.*, Pt. II, pp. 56–97.

43. *Ibid.*, Pt. III, p. 137.

44. See Hist. CFTC, 1941–42, IV, 415–16.

45. *Ibid.*, pp. 411, 416–17; Hist. EFTC, 1941–42, I, 360.

46. Hist. WCACTC, 1941–42, IV, 745–47; Hist. EFTC, 1941–42, I, 20–21, 50–51, 415.

47. Hist. EFTC, 1941–42, I, 416–21.

48. *Ibid.*, p. 18; Hist. CFTC, 1941–42, IV, 411–12.

49. Hist. EFTC, 1941–42, I, 362–66.

50. Ltr., CG GCACTC to Col. F. T. Davison, AC/S A-1, Hq. AAF, 29 Jan. 1942, as cited in Hist. CFTC, 1943, I, 173.

51. *Ibid.*, pp. 174–75.

52. See *ibid.*, pp. 173–84, for a detailed account of the procurement activities of the Snyder boards.

53. Hist. WFTC, 1943, III, 645–47.

54. *Ibid.*, pp. 650-52; Hist. EFTC, 1943, II, 744-47; Hist. AAF Tng. Comd., IV, 785-89.

55. Hist. AAF Tng. Comd., VII, 1365-81; Min. Tng. Eval. Bd. During the fall of 1945 this board made an extensive survey of AAF training of individual specialists, taking testimony from many officers who had served in the various echelons of the training command and the training air forces.

56. See AHS-15, pp. 79-85.

57. *Ibid.*, pp. 85-95.

58. *Ibid.*, pp. 95-99.

59. *Ibid.*, pp. 99-106.

60. *Ibid.*, pp. 107-12.

61. *Ibid.*, pp. 132-34

62. *Ibid.*, pp. 134-35.

63. AFTRC Hq. Prog. Rpt., Mar. 1944, pp. 5-6; *ibid.*, May 1944, p. 27. A total of 43,501 voluntary flying trainee and former AGF and ASF personnel were summarily eliminated from pre-aircrew status during April and May 1944 (Hist. AAF Tng. Comd., III, 432).

64. AFTRC Hq. Prog. Rpt., Apr. 1944, p. 14; *ibid.*, May 1944, p. 13; *ibid.*, July 1944, p. 2; *ibid.*, Sept. 1944, p. 2; *ibid.*, Nov. 1944, p. 13; *ibid.*, Jan. 1945, p. 15; *ibid.*, June 1945, p. 14.

65. AFTRC Hq. Prog. Rpt., Aug. 1944, p. 28; *ibid.*, Sept. 1944, pp. 26-27; *ibid.*, Oct. 1944, p. 34; *ibid.*, Nov. 1944, p. 37; *ibid.*, Feb. 1945, p. 28; *ibid.*, Mar. 1945, p. 2.

66. John M. Coleman, *The Development of Tactical Services in the Army Air Forces* (New York, 1950), pp. 190-91.

67. R. R. Palmer *et al.*, *Procurement and Training of Ground Combat Troops*, pp. 53-54.

68. AAF Stat. Digest, pp. 16, 22.

69. PRS Rpt. #307, p. 3; Samuel Goldberg, *Army Training of Illiterates in World War II* (New York, 1951), table IV, p. 70; incl. 1: memo for C/A sub.: Participation of Negro in the Post-War Military Establishment, 17 Sept. 1945, pp. 1 and 6, tabs E-2 and E-3, in Summary Sheet to WDGS from AC/AS-1, sub. as above, n.d.

70. AAF Stat. Digest, p. 22.

71. Adm. Hist. 12th AF, Pt. 3, Vol. I, 1942-1945; memo cited in n. 69, p. 16; Hist. 477th Composite Group, 1 Mar. 1946-15 July 1946, pp. 1-2.

72. AAF Stat. Digest, pp. 16, 22.

73. Coleman, *Development of Tactical Services*, p. 196.

74. *Ibid.*, pp. 191-96.

75. AHS-28, Development of Administrative Planning and Control in the AAF (revised), pp. 51-52.

76. Hist., AAF Redistribution Station No. 3, Activation thru 30 Sept. 1944, pp. 1-4; Hist. AAF Personnel Distribution Command: Demobilization and Redeployment, pp. 75-76.

77. Hist. AAF Redist. Station No. 3, Activation thru 30 Sept. 1944, pp. 17-20, 68-77.

78. *Ibid.*, p. 77; *ibid.*, Oct.-Dec., 1944, pp. 41-45; AFTRC Hq. Prog. Rpt., Aug. 1944, p. 18.

79. Hist. AAF Redist. Station No. 3, Jan.-Mar. 1945, p. 56.

80. *Ibid.*, Activation thru 30 Sept. 1944, pp. 56-59.

81. *Ibid.*, Jan.-Mar. 1945, pp. 57-62; *ibid.*, July-Aug. 1945, pp. 57-59.

82. *Ibid.*, Apr.-June 1945, pp. 54-64; *ibid.*, July-Aug. 1945, pp. 41-47; Hist. AAF PDC: Redeployment and Demobilization, p. 32.

NOTES TO CHAPTER 16

1. Unless otherwise indicated the discussion of basic military training has been based on AHS-49, Basic Military Training in the AAF, 1939-1944.

2. Quoted in Hist. Organization and Training of Tactical Service Units for Overseas Air Forces, Pt. I, p. 131.

3. Hist. AAF Tng. Comd., Pt. 13, pp. 1313-14.

4. Hist. AAF Tng. Comd., Pt. 6, pp. 316-18; Draft AHS-63, The Procurement, Classification, and Assignment of AAF Enlisted Personnel, Pt. II, pp. 196-200.

5. Draft AHS-63, pp. 185-87.

6. *Ibid.*, pp. 203-4. The complication arose because The Adjutant General's office borrowed many Air Corps test questions and incorporated them in the Army mechanical aptitude test. The scores of men who later took the Air Corps MA test would, of course, be affected by the duplication.

7. *Ibid.*, pp. 187–88.

8. The definition given in AR 615-25, sec. I, par. 1a, p. 1 (31 July 1942), is as follows: "Classification is a process by which pertinent data concerning the enlisted man's education, intelligence, aptitude, previous military experience, civilian work history, interests, hobbies, and other qualifications are validly obtained and correctly recorded to be used as a basis for an assignment in which he will be of the greatest value to the service and will utilize his acquired skills most effectively."

9. Draft AHS-63, pp. 61–62.

10. *Ibid.*, pp. 234–35.

11. *Ibid.*, pp. 10–12.

12. Robert R. Palmer, Bell I. Wiley, and William R. Keast, *The Army Ground Forces: The Procurement and Training of Ground Combat Troops*, U.S. Army in World War II (Washington, 1948), pp. 10–11, 21–22 [hereinafter cited Palmer *et al.*, *Procurement and Training of Ground Combat Troops*].

13. Draft AHS-63, pp. 16–19.

14. Palmer *et al.*, *Procurement and Training of Ground Combat Troops*, pp. 23–25.

15. *Ibid.*, p. 26; Draft AHS-63, pp. 97–99.

16. Draft AHS-63, pp. 223–37.

17. *Ibid.*, pp. 226–27.

18. Hist. AAF Tng. Comd., Pt. 6, pp. 322–24.

19. Draft AHS-63, pp. 206–15.

20. *Ibid.*, pp. 238–40.

21. Hist. AAF Tng. Comd., pp. 324–25.

22. *Ibid.*, pp. 274–86.

23. Interview with Brig. Gen. Charles R. Glenn, USA, Surgeon, AFTRC, 5 Dec. 1943.

24. Hist. AAF Tng. Comd., Pt. 6, pp. 336–37.

25. "The Aviation Psychology Program of the Army Air Forces," *Psychological Bulletin*, Vol. 40 (Dec. 1943), 759–69.

26. *Ibid.*, p. 763; Hist. AAF Tng. Comd., Pt. 6, pp. 338–40.

27. Interview with Brig. Gen. Walter F. Kraus, CG CFTC, 24 May 1944.

28. Hist. AAF Tng. Comd., Pt. 6, pp. 341–43.

29. Glenn interview cited in n. 24.

30. Annual Rpt. Psych. Div., Off. The Air Surgeon, Hq. AAF, 1942, p. 2.

31. Hist. AAF Tng. Comd., Pt. 6, pp. 350–53.

32. Hist. EFTC, 1942, I, 343–48; Hist. CFTC, 1941–1942, III, 292–94, 297–99; TWX, WCACTC to AFFTC, 19 Mar. 1942.

33. Glenn interview cited in n. 24.

34. Hist. AAF Tng. Comd., Pt. 6, pp. 356–57.

35. Hist. Nashville Army Air Center, I, 205.

36. Hist. San Antonio Aviation Cadet Center, 4 July 1942–1 Mar. 1944, Vol. II, supporting document.

37. Hist. WCTC, 1942, II, 262.

38. Hist. AAF Tng. Comd., Pt. 6, pp. 360–62.

39. Lt. Col. J. C. Flanagan and Maj. P. M. Fitts, Jr., "Psychological Testing Program for the Selection and Classification of Air Crew Officers," *The Air Surgeon's Bulletin*, I (June 1944), 1–5.

40. Hist. AAF Tng. Comd., Pt. 6, pp. 362–63, 383.

41. *Ibid.*, p. 363.

42. *Ibid.*, pp. 364–67.

43. The San Antonio Aviation Cadet Center, for example, prepared an illustrated booklet entitled "Together We Fly." Similar booklets were used at the other centers.

44. Hist. WFTC, 1943, I, 133–39.

45. Hist. San Antonio Aviation Cadet Center, 1942–44, p. 54; Hist. CFTC, 1943, II, 335.

46. Hist. AAF Tng. Comd., Pt. 6, pp. 369–70, 376.

47. *Ibid.*, p. 377.

48. For instances of forced classification of bombardiers and navigators, see Hist. Maxwell Fld., 1941–42, pp. 147–48.

49. Hist. AAF Tng. Comd., Pt. 6, pp. 377–78.

50. Hist. WCTC, 1942, II, 266.

51. *Ibid.*, p. 269; Hist. CFTC, 1943, II, 329; Hist. Nashville Army Air Center, I, 483.

52. Hist. AAF Tng. Comd., Pt. 6, pp. 378–79.

53. Tng. Comd., Reorganization Plan for Classification of Army Air Force Personnel (Tab B), n.d.

54. Hq. AFTRC, Med. Sec., Progress Rpt., Feb. 1944; interview with Maj. P. H. DuBois, Psych. Resch. Sec., Hq. AFTRC, 14 May 1945.

55. Hist. AAF Tng. Comd., Pt. 6, pp. 382–83.

56. *Ibid.*, pp. 383–85.

57. *Ibid.*, pp. 387–99. "In a follow-up study of both bomber and fighter pilots in the European theater, it was determined that pilots who had scored highest in the psychological tests administered before they learned to fly tended to be rated by the squadron commanders as most successful in combat. Likewise, those who had the minimum acceptable scores appeared to be most frequently 'missing in action.'" (Second Report of the Commanding General of the Army Air Forces to the Secretary of War, 27 February 1945, p. 89.)

58. Second Report of the Commanding General of the Army Air Forces to the Secretary of War, 27 Feb. 1945, p. 88.

59. In addition to the articles cited in notes 26 and 40 above, attention is directed to seven other articles prepared by the various psychological research units and which appeared in the *Psychological Bulletin*, Vols. 41 (1944) and 42 (1945).

NOTES TO CHAPTER 17

1. Maj. Gen. B. K. Yount, "Building the AAF: Part I, Pre-flight Toughens 'Em," *Aviation* (Aug. 1943), p. 124, in AHS-48, Preflight Training in the Army Air Forces, 1939–1944, p. 1.

2. TC Memos 35-17, 14 Apr. 1944; 50-23-1, 23 May 1944; and 50-27-1, 12 May 1944.

3. Ltrs., OCAC to CO SETC, 1 and 2 Oct. 1940.

4. FTC Memos 50-1-1, 21 Apr. 1943; 50-23-1, 19 Feb. 1943.

5. TC Memo 50-23-1, 23 May 1944.

6. Hist. SAAAB, 7 Dec. 1941–31 Dec. 1942; Hist. SAACC, May-June 1944, p. 18.

7. Memo for Maj. Gen. B. K. Yount from Col. K. P. McNaughton, 16 Nov. 1942; Hist. EFTC, 1942, pp. 390–91.

8. Hist. EFTC, 1942, p. 360; Hist. SAAAB, 1942, p. 210, and Jan.–Feb. 1944, pp. 38–39.

9. TC Memo 50-27-1, 12 May 1944 and 13 Apr. 1945; Hq. AFTRC, Conf. on Preflight Training, 10–11 July 1944.

10. AAF Reg. 50-14, 23 Sept. 1943; Hist. SAAAB, 1943, pp. 144–45; TC Memo 50-21-10, 9 Nov. 1944.

11. AG 201.1 (21 Jan. 1942) RB-A, 26 Jan. 1942; AC/AS, A-1 to CG AFFTC, 31 July 1942.

12. Hist. EFTC, 1942, pp. 363–64; Hist. WFTC, 1943, pp. 597–98; Hist., Randolph Fld., 1931–44, p. 235.

13. WFTC Tng. Memo 26, 24 Mar. 1943.

14. Memo for AC/S G-1 from Maj. Gen. G. E. Stratemeyer, 13 Dec. 1942; AAF to AAFFTC, 17 Jan. 1943; memo for CG AAF, 7 Jan. 1943, in Hist. of AAF Tng. Comd. and Pred. Comds., 1939–1945, pp. 400–404.

15. TWX, AFTRC to AAF, 1 Dec. 1944; Daily Diary, Hq. AAFFTC, 23 Apr. 1943.

16. Hq. AAFFTC, Flight Table "E," (rev. 23 Jan. 1943; 11 Feb. 1943); FTC Memos 50-25-1, 24 Feb. 1943, and 25 Nov. 1943; interviews, Maj. C. H. Dabezies, A-3 Div., Hq. AFTRC, 22 Jan. 1945; Col. P. C. Potter, A-3 Div., Hq. AFTRC, 25 Jan. 1945; Maj. P. M. Ferguson, A-3 Div., Hq. WFTC, 3 June 1943.

17. Hist. CFTC, 1943, pp. 1064-65; interview, Lt. T. H. Greer, Preflight School, SAAAB, 2 Feb. 1944.

18. Memo for CG AAF from Col. T. J. Dubose, 10 Jan. 1943; Dabezies interview cited in n. 16; Hist. WFTC, 1943, pp. 1057–59; TWX, AAF to AFTRC, 12 Jan. 1944; memo for C/S from Hq. AFTRC, A-3, 17 Jan. 1944.

19. Memo for C/S from Hq. AFTRC, AC/S, 24 Nov. 1943; TWX, AFTRC to 3 FTC's, 1 Jan. 1944; memo for C/S, G-3 from CG AAF, sub.: Elimination of AAFTC Prog., 30 Mar. 1944; memo for CG AAF from OC/S, 31 Mar. 1944.

20. Interviews, Maj. F. P. Dunne, A-1 Div., Hq. AFTRC, 17 Sept. 1945; Lt. Col. D. E. Ellett, OC/S Hq. AFTRC, 24 Sept. 1945, in TC Hist., pp. 429–31.

21. AFTRC to EFTC, 27 Jan. 1944; Ellett interview cited in n. 20; Hq. AFTRC, Table, Rpt. of Flying Training Students, Dec. 1944, p. 2; AAF to AFTRC, 4 Dec. 1944; Hist. CFTC, Jan.–June 1944, p. 751; Hist. WFTC, Nov.–Dec. 1944, pp. 196–97; AFTRC to EFTC, 23 Sept. 1944.

22. AFTRC to AAF, 17 Oct. 1944; Brig. Gen. K. P. McNaughton, C/S

AFTRC to Brig. Gen. W. W. Welsh, AC/AS Training, 20 Dec. 1944; AFTRC to EFTC, 13 Mar. 1945; Dunne and Ellett interviews cited in n. 20.

23. Hist. CFTC, 1 Jan. 1939–7 Dec. 1941, I, 10–11; III, 220–21.

24. TC Memo 50-9-1, 11 Oct. 1945; TC Hist., pp. 547–49.

25. AHS-18, Pilot Transition to Combat Aircraft, pp. 1–2, 37–39, 58–67.

26. Hist. AAF Tng. Comd., pp. 600–601, 671.

27. Hist. EFTC, 1 Jan. 1943–31 Dec. 1943, I, 276–77; Hist. WCTC, 7 Dec. 1941–31 Dec. 1942, IV, 971–72; Med. Hist., CFTC, 1940–44, p. 160; Hist. of 1st FTD, Santa Maria, Calif., 1 Mar. 1944–30 Apr. 1944, App.; and TC Memo 50-8-2, 30 May 1944.

28. Hq. AFTCC, Progress Rpt., Dec. 1943; tables, Rpt. of Flying Training Students, Dec. 1944, Aug. 1945.

29. Program of Instruction: Elementary Flying Training, revisions of 6/1/39 and 5/22/40; ACTD, Hemet, Calif. to WCACTC, 25 Mar. 1941; Program of Instruction: Elementary Flying Training, 15 Jan. 1943; TC Memo 50-8-1, 9 May 1944.

30. TM 1-212, Basic Flying, 20 Jan. 1942, pp. 1–2; *Hearings* on H.R. 4124, 25 Mar. 1941, before the Senate Subcommittee of the Committee on Appropriations, 77 Cong., 1 Sess., p. 34; R&R, Hq. AAF, Management Control Sec. to C/AS, 19 May 1944; Hist. WCACTC, 8 July 1940–7 Dec. 1941, II, 275–85; Hist. EFTC, 1 Jan. 1943–31 Dec. 1943, II, 376–79.

31. Hist. CFTC, 1939–41, III, 214–16; C/AC to GCACTC, 25 Oct. 1940; interview, Col. James H. Price, DAC/S, A-3 Div., Hq. AFTCC, 16 Nov. 1944; III Bomber Comd. to 3d AF, 8 June 1942; FTC Memo 50-9-1, 21 Apr. 1943; TC Memo 50-9-1, 8 May 1944.

32. Proceedings of a Board of Officers Convened for the Purpose of Investigating Instrument Flying and Instrument Flying Training in the AAF [late 1942]; WCAAFTC to AFFTC, 10 Oct. 1942; SEAAFTC to AFFTC, 30 Oct. 1942; GCACTC Tng. Memo 151, 12 Dec. 1941; Tech. Note 66-42, BuAer., Navy Dept., 21 Aug. 1942; TWX, AFTCC to WFTC, 26 Feb. 1944.

33. TC Memo 50-9-2, 1 Oct. 1943; TC Memos 50-9-1, 50-9-2, 50-9-3, 8 May 1944; Hist. CFTC, 1 Sept. 1944–31 Oct. 1944, II, 220; TC Memos O-2D, 24 Apr. 1945; 50-9-1, 20 Apr. 1945.

34. OCAC to TC's, 12 Oct. 1940.

35. AC/AC to GCACTC and SEACTC, 7 July 1941; AFRIT to 1st, 3d, and 4th AF's and AFFTC, 1 Apr. 1942; Hist. CFTC, 1942, IV, 435; Hist. Moore Fld., 1941–44, pp. 24–26.

36. FTC Memo 50-10-1, 15 May 1943; 2d ind. (AFRIT to AFFTC, 14 June 1942), AFFTC to GCAAFTC, 15 July 1942; TC Memos 50-10-4, 1 May 1944; 50-10-4A, 19 May 1944; 50-2-7, 10 Aug. 1944; Hist. EFTC, 1942, II, 465–69; Hist. WCTC, 1942, II, 347; Hist. CFTC, 1942, IV, 467–69; AFRIT to AFFTC, 2 Nov. 1942; FTC Memos 50-10-1, 21 Apr. 1943, and 50-10-8, 19 May 1943.

37. Program of Instruction, Advanced Flying Tng., Two-Engine; TC Memo 50-10-2, 19 Apr. 1944.

38. Hist. EFTC, 7 Dec. 1941–31 Dec. 1947, III, 789–94; interview, Col. W. H. Blanchard, A-3 Div., Hq. AFTRC, 5 Oct. 1943; AAF to AFFTC, 26 Aug. 1942; AAF to AFFTC, 25 Sept. 1942; AFTRC to AAF, 5 Feb. 1944; Hq. AFTRC, Progress Rpt., Jan. 1944; AFTRC to WFTC, 22 Oct. 1944; interview, Lt. Col. A. J. Perna, A-3 Div., AFTRC, 30 Apr. 1945; AFTRC to EFTC, 26 Apr. 1945.

39. Hq. AFFTC, Project Outline, 8 Sept. 1942; Daily Diary, Hq. AFFTC, A-3 Div., 2 Oct. 1942; FTC Memo 50-2-1, 14 Apr. 1943; Hist. EFTC, 1943, II, 585–96; TC Memo 50-2-3, 7 Jan. 1944; TC Memo 50-2-3, 21 Apr. 1944; AFTRC to 3 FTC's, 16 May 1944; TC Memo 50-2-3B, 27 July 1944.

40. TC Memo 50-26-12, 11 May 1944; Hist. CFTC, 1 Sept. 1944–31 Oct. 1944, pp. 208–9; Hist., EFTC, Jan.–June 1944, I, 246, 529.

41. Hist. CFTC, 1939–41, III, 227, 390–92; Proceedings of a Board of Officers Convened for the Purpose of Investigating Instrument Flying and Instrument Flying Training in the AAF [late 1942]; FTC Memo 50-1-1, 1 Feb. 1943; Hist. CFTC, 1942, IV, 443, 492; Hist. EFTC, 1942, II, 525–26, 557–60, 596–99, 645–47, 748, 750.

42. TC Memo 50-26-12, 11 May 1944, Addendum No. 1.

43. R&R, OCAC, T&O Div. to Mil. Pers. Div., 31 July 1941; TC Memos 50-27-7, 22 July 1943, 50-27-16, 2 Oct. 1944, and 3 May 1945; FTC Memo 50-1-1, 21 Apr. 1943; TC Memo 50-27-1, 12 May 1944 and 13 Apr. 1945; interview, Maj. A. J. Perna, A-3 Div., Hq. AFTRC, 22 Dec. 1944; Hist. WCTC, 1942, II, 692–93; III, 693.

44. Hist. of EFTC, 1943, II, 398–403, 566–67.

45. Hist. CFTC, 1942, IV, 420–21; Hist. WFTC, 1 July 1944–31 Aug. 1944, I, 189, 570.

46. Air Tng. Comd., Evaluation of Individual Training in the Army Air Forces, 1946, p. 21.

47. Hist. WCTC, 7 Dec. 1941–31 Dec. 1942, III, 572; Hist. EFTC, 1 Jan.–30 June 1944, I, 297; WFTC Memo 50-9-1, 23 June 1944; Hist. WCTC, 1942, III, 577; memo for Col. W. R. Carter from Lt. Col. James H. Price, Hq. AFFTC, A-3 Div., 18 Aug. 1942; AFFTC to AAF, 27 Nov. 1942; Hist. CFTC, Jan.–June 1944, V, 827; Mar.–Apr. 1945, pp. 492–93; 1 July–31 Aug. 1945, pp. 312–13; TC Memo 50-1-3, 5 July 1945; Hist. Randolph Fld., 1931–44, pp. 229–33, 240–43, 246; FTC Memo 37-2, 19 Apr. 1943; Hist. CIS, Mar.–May 1944, p. 33.

48. Evaluation of Individual Training in the Army Air Forces, p. 19.

49. Hist. WCACTC, 1940–41, II, 229–30; Hist. WFTC, 1942, II, 308–10; Hist. EFTC, 1942, II, 463, IV, 1480–81; 1943, I, 345–47, IV, 1459–61; Hq. AFTRC, Progress Rpt., July 1944, p. 29; Hist. CFTC, Nov.–Dec. 1944, IV, 126–29.

50. Hist. WFTC, 1943, I, 239, 574–76.

51. Special War Dept. Monthly Report on Airplanes, July 1942; Hist. EFTC, 1942, III, 768, 770–72 and app., chap. XL, p. 2; 1943, IV, 1465–69; Hist. WCTC, 1942, II, 369–70; 1943, II, 295–96; Hist. CFTC, 1943, II, 434–35; interview with Col. Walter S. Lee, A-4 Div., Hq. AFTRC, 6 May 1944; SEACTC to OCAC, 1 Apr. 1942; memo for AFRIT from OCAC, AFRDB, 5 July 1942; AFRIT to AFRDB, 8 July 1942; Daily Diary, Hq. AFTRC, A-3 Div., 21 July 1943; 8 Aug. 1943; Tables, Report of Flying Time of Aircraft and Personnel, Hq. AFTRC, Dec. 1944–May 1945.

52. AAF Stat. Digest, tables 46–47.

53. *Ibid.*, tables 47–48; interview, Col. Norman L. Callish, A-3 Div., Hq. AFTRC, 16 Nov. 1944; Price interview, in Hist. AAF Tng. Comd., pp. 571–74.

54. Hist. EFTC, 1943, App., chap. IX, doc. 3, and pp. 537–38.

55. AHS-5, Individual Training of Bombardiers, pp. 1, 18–34, 42; interview, CWO T. J. Kelly, A-3 Div. AFTRC, 5 Mar. 1946; Hist. Lowry Fld., 1 Jan. 1939–7 Dec. 1941, II, 180–90, in Hist. AAF Tng. Comd., pp. 877–85.

56. R&R #1, C/AS to C/AC, 26 Sept. 1941; Daily Diary, AFRIT, 23 Sept. 1942; AFFTC, Consolidated Flying Training Report, Dec. 1942, Jan., Feb., and July 1943; memo for Col. T. J. Dubose from Maj. E. H. Herzog, 22 Dec. 1942; R&R, AFMSC to AFIHD, 15 Oct. 1943, in AHS-5, pp. 58–88.

57. AFFTC to GCAFTC, 16 Apr. 1942; AAF to all Air Forces and AAF Comds., 28 July 1942; 2d ind. (4th AF to AAF, 3 Nov. 1942), AAFFTC to AAF, 11 Dec. 1942; AAF to AAFFTC, 15 May 1943.

58. TC Memo 50-11-1, 16 June 1943, 20 Aug. 1943, 29 Sept. 1943, 30 June 1944; interview, Maj. P. P. Dawson, A-3 Div., Hq. AFTRC, 22 Mar. 1946; FTC Memo 50-11-2, 19 Apr. 1943; Hist. WCTC, 1942, II, 447–48, 898–99, 910–15.

59. FTC Memo 50-11-2, 19 Apr. 1943; FTC Memo 50-11-1, 16 June 1943; TC Memo 50-11-1, 20 Aug. 1943, 29 Sept. 1943, 18 Feb. 1944, 30 June 1944; AHS-5, pp. 53–56.

60. TWX, AFTRC to CFTC and WFTC, 10 May 1944; AAFFTC to GCTC, 13 Jan. 1943; TC Hist., pp. 904–5.

61. TC Memo 50-11-5, 6 Aug. 1943, 2 Feb. 1944; AFTRC to CFTC and WFTC, 29 Mar. 1944.

62. AHS-5, pp. 89–114.

63. TM 1-250, 7 Mar. 1941; Min. Bombardier and Navigation Conf., Hq. AFTRC, 25 Oct. 1945; Hist. Kirtland AAF, 1 July–31 Aug. 1944, pp. 216–17; interview, CWO T. J. Kelly, A-3 Div., Hq. AFTRC, 25 June 1944; AFTRC to CFTC, 1 Mar. 1944; Daily Diary, Hq. AFTRC, A-3 Div., 22 Apr. 1944.

64. Hist. Big Spring AAF, 1 Nov.–31 Dec. 1944, pp. 87–88.

65. AFTRC to AAF, 12 Aug. 1943; FTC Memo 50-11-6, 5 July 1943; AAF-

FTC to AAF, 2 July 1943; AHS-5, pp. 99–110.

66. Daily Diary, Hq. AFTRC, A-4 Div., 30 Sept. 1943; Hist. Big Spring AAF, 1 Nov.–31 Dec. 1944, p. 178.

67. Daily Diary, Hq. AFFTC, 20–21 June 1942, 13 Jan. 1943; General Yount's Project Book, Bombardier Training, 20 Aug. 1943; memo for Lt. Col. E. H. Herzog from Capt. H. O. McTague, 13 Aug. 1943.

68. Daily Diary, Hq. AAFFTC, A-4 Div., 18 Apr. 1943; TWX, AFTRC to AAF, 23 Sept. 1944; Hist. Kirtland AAF 1 July–31 Aug. 1944, p. 95.

69. Stat. Control Sec., Hq. AFTRC, Chart, Bombardier Graduates, 1946.

70. R&R, ACFTC to Asst. for Pers., Hq. AAF, 21 Feb. 1942; memo for Maj. W. S. Lee, Bombardier Sec., OCAC from Capt. E. C. Plummer, 17 Jan. 1942; Daily Diary, AFFTC, A-3 Div., 20 Oct. 1942; Daily Diary, AAFFTC, A-3 Div., 19 May 1942.

71. AFFTC to TC's, 26 May 1942; Min. Bombardier and Navigation Conf., Hq. AFTRC, 25 Oct. 1945; Chart, Bombardier Graduates, cited in n. 69.

72. AFTRC to WCTC, 16 Aug. 1943; Maj. Gen. C. L. Tinker, Hq. Hawaiian AF to C/AAF, 24 Feb. 1942; AHS-27, Individual Training of Navigators in the AAF, pp. 173–75.

73. AHS-27, pp. 186–87.

74. *Ibid.*, pp. 181–82.

75. *Ibid.*, p. 185; FTC Memo 50-12-1, 15 Apr. 1943 and 22 July 1943; interview, 1st Lt. W. A. Bennett [rated navigator], AFSHO, 16 Jan. 1947.

76. CG AFFTC to AFRIT, 12 Jan. 1943, in AHS-27, pp. 82–83, 182–83; TC Hist., p. 820.

77. Hist. EFTC, 1 Jan. 1943–31 Dec. 1943, III, 792–97, 819; AHS-27, pp. 84, 183.

78. R&R, C/AC to C/AAF, 15 Sept. 1941; R&R, AFRDB to AFRIT, 3 Feb. 1943; Daily Diary, AFFTC, A-1 Div., 5 Oct. 1942; Daily Diary, AFTRC, A-1 Div., 23 Dec. 1943; AHS-27, pp. 135–48, 158–60.

79. Hist. WFTC, 1943, II, 486–87; AFTRC to WCTC, 21 July 1943; memo for C/Non-pilot Sec., A-3 Div. from Hq. AFTRC, Maj. J. H. Kusner, A-3 Div., 16 Nov. 1943; TC Hist., pp. 862–76.

80. AHS-27, p. 186; AAF to AFTRC, 26 Nov. 1943; AAF to AFTRC, 8 Nov. 1943; AFTRC to CFTC, 21 Nov. 1944; AFTRC to CFTC, 15 Dec. 1943; 3d ind. (AAF Nav. Instr. School (N), Selman Fld., La., to AFTRC, 24 Apr. 1944), AFTRC to CFTC, 14 May 1944; AFTRC to FTC's, 2 Aug. 1943; TC Hist., pp. 848–55.

81. Dawson interview, in TC Hist., pp. 859–60.

82. TWX, ACFTC to GCAFTC, 7 June 1942; Hist. CFTC, Mar.–Apr. 1945, I, 215; TC Hist., pp. 855–57.

83. R&R #1, AFRDB to AFRBS thru AFRIT, 9 Sept. 1942; R&R #7, AC/AS MM&D to AC/AS Training, 6 Apr. 1944; Rpt. of AAF Board, Project No. (M-4) 537, 5 May 1944; CG AFFTC to AFRIT, 26 Feb. 1943, in AHS-27, pp. 168–72.

84. Chart, Navigator Graduates, in TC Hist., p. 846.

85. Psych. Sec., Office of the Surgeon, Hq. AFTRC, Table VI, September 1944 Test Battery; Dawson interview cited in n. 81; interview, Capt. A. R. Kooker, Hist. Off., Hq. AFTRC, 17 Oct. 1944.

86. TC Memo 50-12-1, 22 Nov. 1943, in AHS-27, pp. 84–85; Chart, Navigator Graduates, in TC Hist., p. 846.

87. Lt. Gen. H. H. Arnold and Col. I. C. Eaker, *Winged Warfare*, p. 45; Gen. H. H. Arnold to AAFFTC, 29 June 1943; TC Hist., pp. 978, 1018.

88. R&R, OCAC, Maj. Lee to C/Tng. Div., Nov. 1941; Table, Flexible Gunnery Training Schools, in TC Hist., pp. 981–83.

89. Memo for General Perrin from Brig. Gen. R. W. Harper, 3 Sept. 1943; C/AS to CG's all AF's, Comds., etc., 1 Dec. 1942; Brig. Gen. R. W. Harper to CG AFFTC, 27 Apr. 1943; Brig. Gen. R. W. Harper to CG AFTRC, 3 Aug. 1943, in AHS-31, Flexible Gunnery Training in the AAF, pp. 13–16.

90. Chart, Flexible Gunnery Graduates, in TC Hist., p. 985; AAF Stat. Digest, tables 47, 50; Hq. AFTRC, Project Book; TWX, GCAFTC to AFFTC, 18 Apr. 1942; AAF Reg. 35-17, 10 Feb. 1943, in TC Hist., pp. 984–89.

91. TWX, AFTRC to EFTC, 26 Oct. 1943; Gunner's Information File (AAF Manual 20), rev. Feb. 1945, in Hist.

EFTC, 1 Mar. 1945–30 Apr. 1945, I, 372, 1047–49; AHS-31, pp. 100–101.

92. Hist. EFTC, 1942, III, 983–84; 1943, III, 871–72; Rpt. of Conf. on Flexible Gunnery, 6 June 1942; Col. L. W. McIntosh, Rpt. of Training Inspection of AFTRC Flexible Gunnery Schools, 11 Aug. 1943, in TC Hist., pp. 999–1000.

93. Hist. Kingman AAF, 1943, p. 48; Hist. EFTC, 1942, III, 962, 965–66, 986–89; 1943, III, 880–83; Col. L. W. McIntosh, Rpt. of Tng. Inspection of AFTRC Flexible Gunnery Schools, 11 Aug. 1943.

94. AAF to AFTRC, 31 Aug. 1944; Hist. of EFTC, Nov.–Dec. 1944, I, 389; Hist. WFTC, Mar.–Apr. 1945, II, 254–55; May–June 1945, I, 138–39, 1054–55; AHS-31, pp. 63–71.

95. AFTRC to AAF, 1 Dec. 1943; AAF to AFTRC, 4 Dec. 1943; AFTRC to EFTC and WFTC, 30 Aug. 1944; memo for Gen. H. H. Arnold from Hq. AFTRC, 12 Dec. 1944; interview with Lt. H. D. Shearn, Frangible Bullet Off., Laredo AAF, 29 Oct. 1945; Daily Diary, Hq. AFTRC, A-4 Div., 4 Aug. 1945, 5 Aug. 1945, in TC Hist., pp. 1056–58.

96. Hist. EFTC, 1942, III, 953–55; 1943, III, 863, 892–93, 903; AFRIT to AAFFTC, 15 Feb. 1943; memo for Col. Harding from Maj. R. F. Worden, Hq. AAFFTC, 17 Oct. 1942; FTC Memo 50-13-3, 17 Feb. 1943; TC Memos 50-13-1A, 31 Aug. 1943; 50-13-2, 19 Aug. 1944; Hist. Laredo AAF, Jan.–Feb. 1945, III, 99–100; interview, Capt. A. H. Payne, Jr., CSFG, 30 Oct. 1945.

97. TWX, AAF to AFTRC, 6 Mar. 1944; Hist. Buckingham AAF, 1 Nov.–31 Dec. 1944, II, 17–20; 1 Mar.–30 Apr. 1945, II, 58–74, 107; memo, Hq. AFTRC, Rpt. of Conf., 9 Oct. 1944; Daily Diary, Hq. AFTRC, OD/FG, 25 Apr. 1945, Hq. AFTRC, A-1 Div., 28 July 1945; AFTRC to EFTC, 22 May 1945.

98. AAFFTC to AAF, 23 Feb. 1943.

99. Sheppard Fld., Texas, to AAFTTC, 12 May 1943; AAF to AFTRC, 9 Oct. 1943; AAF to AFTRC, 9 Mar. 1944; AFTRC to AAF, 13 Apr. 1944; AFTRC to AAF, 7 Feb. 1945; Stat. Control Sec., Hq. AFTRC, Special Rpt., 18 Jan. 1945.

100. Hist. Amarillo AAF, May–June 1945, III, 101-2; TC Memo 50-32-8, 7 July 1944; Course Outline for B-29 Flight Engineer Course, Lowry Fld., Colo., 1 Nov. 1944.

101. WTTC to AFTRC, 8 Feb. 1944; Lowry Fld., Colo., to WTTC, 26 Aug. 1944.

102. Hist. Boca Raton AAF, 1 May–30 June 1944, App. B, Item 12; AFTRC to ETTC, 16 Sept. 1944; AFTRC to WFTC, 20 Sept. 1944; AFTRC to AAF, 1 Dec. 1944; AFTRC to WFTC, 22 Dec. 1944; AAF Stat. Digest, table 50.

103. Hist. Boca Raton AAF, 7 July 1943–1 Mar. 1944, app. B, Items 8-10; Radar Standardization Bd., Chart, AAF Radar Tng., in Monograph on Communications Training, 1 Jan. 1939 to 31 Dec. 1944 (rev.), pp. 46–63.

NOTES TO CHAPTER 18

1. Stat. Control Div., Office of Management Control, Chart, Development of AAF Program, 5 Aug. 1944; Tng. Policies and Opns. in the 4th AF thru the Year 1941, pp. 31–33; Hist. III Ftr. Comd., 21 Apr.–6 Dec. 1941, pp. 35–36; Hist. III Rcn. Comd., 7 Dec. 1941–30 Sept. 1943, p. 2.

2. Rpt., Maj. R. B. Williams, military observer to Great Britain, 29 Apr. 1941.

3. Ltr., III BC to 3d AF, 18 Jan. 1942, with incl.; ltr., AFCC to 2d AF, 2 Feb. 1942, with incl.; ltr., AAF to 1st AF, 2 May 1942.

4. Hist. 2d AF, 1943, pp. 570–72; Tng. and Testing at AAFSAT, Bombardment, Nov. 1942–Oct. 1943, I, 13–14, 128, 134–35, 139–40.

5. Hist. 2d AF, 1943, pp. 570–71; Ftr. Tng. in the 4th AF, 1942–1945, pp. 23–24, 39–40, 44; Bombardment Tng. in the 4th AF, 1942–1945, p. 108.

6. Ftr. Tng. in the 4th AF, 1942–1945, p. 41.

7. Memo for Brig. Gen. R. W. Harper, 31 May 1943; Outline Hist. I TCC, 24 Sept. 1943, p. 1.

8. Orgn. chart, Unit Tng. Div., AC/AS Tng., Hq. AAF, 1 Oct 1943; CAF GO 9, 16 Apr. 1945.

9. AAF Stat. Digest, table 52, Crews Completing Training in Continental U.S., by Type: Dec. 1942–Aug. 1945.

10. AAF tng. standards, series 20-, 30-.

11. Memo for Arnold, CG AAF from

CG's 4 continental air forces, 21 Aug. 1943; Hist. 2d AF, 1943, pp. 570–72, 584, 588; Hist. 3d AF, Flying Tng., 1941–1944, pp. 280–81.

12. Interviews with Capt. W. A. Bennett (navigator), Capt. J. W. Miller (navigator), Capt. G. W. Satterfield (bombardier-navigator), 24 Aug. 1948.

13. Ltrs., AC/AS OC&R to 2d AF, 5 May 1943, 27 Aug. 1943; C/AS to ATC, 12 Aug. 1943; AAF to AFTRC, 20 Dec. 1943; AFTRC to CFTC, 13 May 1944; Hq. AFTRC Project Bk., in Hist. AAF Tng. Comd., 1 Jan. 1939–V-J Day, IV, 744–46.

14. Interview with Maj. A. J. Perna, A-3 Div., Hq. AFTRC, 29 Mar. 1945; TC Memo 50-2-10, 2 Apr. 1945, in Hist. AAF Tng. Comd., IV, 727, 735–37, 742; ltr., AAF to AFTRC and 2d AF, 30 Oct. 1944, with inds.; AAF Tng. Standard 20-3, Very Heavy Bombardment Crews, 6 July 1944.

15. AAF Stat. Digest, table 52.

16. AAF tng. standards, series 10-.

17. Ltr., Gen. P. M. Robinett to Gen. G. C. Marshall, 8 Dec. 1942; memo for C/Opns Div., WDGS from AC/AS A-3, n.d.; ltr., AAF to 3d AF, 25 Feb. 1943; Daily Diary, Unit Tng. Div., 18 Sept. 1943.

18. Hist. III Ftr. Comd., Installment II, Pt. II, 7 Dec. 1941–21 July 1944, p. 90; Daily Diary, Unit Tng. Div., 14–15 Aug. 1943; ltr., AAF to 4th AF, 10 Nov. 1943.

19. Bombardment Tng. in the 4th AF, 1942–1945, pp. 27–29; Critique on 4th AF Tng. Exercise No. 7, 21–24 May 1943.

20. Memo for Gen. H. H. Arnold from CG's continental air forces, 21 Aug. 1943.

21. AAF tng. standards, series 200-; Hq. 1st AF memo 50–36, Ftr.-Bomber Tng., 1 Mar. 1944, in Ftr. Tng. in the 4th AF, 1942–1945, Doc. 73.

22. Hist. 2d AF, 7 Dec. 1941–31 Dec. 1942, pp. 157–58; memo for AC/AS Tng., Hq. AAF from 3d AF, 8 Apr. 1943; ltr., AAF to 1st AF, 10 Apr. 1943; memo for DC/AS from AC/AS, Tng., Hq. AAF, 7 July 1944.

23. 1st ind. (ltr., AAF to 3d AF, 15 May 1942), 3d AF to AAF, 2 June 1942; ltr., AAF to 2d AF, 12 June 1943, with inds.; Rpt. of Tng. Conf. held at AAFSAT, Orlando, Fla., 18 May 1943; Rpt. of Tng. Conf. held at Hq. 2d AF, Colorado Springs, Colo., 20–22 Sept. 1943.

24. Rpt. for Gen. H. H. Arnold submitted by Dir. Mil. Requirements, 28 Dec. 1942; ltr., 3d AF to AAF, 6 Sept. 1942; Hist. 2d AF, 7 Dec. 1941–31 Dec. 1943, pp. 132, 167; Ftr. Tng. in the 4th AF, 1942–1945, pp. 36–37; ltr., AAF to 3d AF, 23 June 1943, with inds.

25. Ftr. Tng. in 4th AF, 1942–1945, p. 38.

26. Admin. Policies and Problems in the 4th AF, 1942–1945, pp. 312–16, 334–35.

27. Memo for DC/AS from AC/AS OC&R, 4 Jan. 1944; ltr., 2d AF to AAF, 6 Nov. 1944; Ftr. Tng. in the 4th AF, pp. 47–48, 66, Doc. 60-60A.

28. Hist. 73d Bomb. Wing VH Spec., 1 May 1944–30 June 1944, II, 18–20; Admin. Problems and Policies in the 4th AF, 1942–1945, pp. 317–23; Ftr. Tng. in the 4th AF, 1942–1945, pp. 8–9, 41.

29. Ltr., VIII Ftr. Comd. to 8th AF, 15 Sept. 1942, with ind.; CM-IN-6560 #A304, CINC SWPA to CG AAF, 18 Aug. 1942.

30. Rpt. from APO 634, 19 Feb. 1943; ltr., 10th AF to AAF, 24 Dec. 1943, with inds.; ltr., V BC to 5th AF, 7 July 1943, with incls.; ltr., Gen. Ira Eaker to Maj. Gen. B. M. Giles, 13 May 1943.

31. Ltr., AAF to TRC, 8 Sept. 1944; interview with Lt. Col. Oscar Coen, Unit Tng. Div., AC/AS Tng., 15 Mar. 1945.

32. Ltr., AC/AS Tng. to 3d AF, 29 July 1943; ltr., AC/AS Tng. to 2d AF, 31 Aug. 1943, with ind.; ltrs., AC/AS Tng. to 2d AF, 16 Oct. 1943; AAF to 2d AF, 27 Apr. 1944; AAF to 1st AF, 17 July 1944; AAF to 3d AF, 17 Aug. 1944; memo for C/AS from AC/AS Tng., 8 Sept. 1944; AAF to 2d AF, 17 Aug. 1944.

33. AAF Ltr. 50-48, 2 Aug. 1944; ltr., AAF to 1st, 2d, 3d, and 4th AF's, 27 Oct. 1944, with inds.; memo for AC/AS OC&R from AC/AS Tng., 26 June 1944; ltr., AC/AS Tng. to 1st AF, 27 Sept. 1944; memo for AC/AS OS&R from AC/AS Tng., 10 Oct. 1944; interview with Lt. Col. George Prentice, Unit Tng. Div., AC/AS Tng., 5 May 1945.

34. Hist. CFTC, 1934, IV, 701–6; Hist. Brooks Field, 1917–44, Pt. I, pp. 19, 26; Pt. II, App. II, pp. 1, 3, 11–12, 15–17; Daily Diary, Hq. AFTRC, A-3 Div., 10 July 1943.

35. Memo for TAG from OCAC, 29 May 1941; Tng. Policies and Opns. in the 4th AF thru the Year 1941, pp. 75–76, 80–96, 121–22; interview with Lt. Col. John E. Murray, Policy and Tactical Employment Br., AC/AS-3, 13 June 1946.

36. Ltr., AAF to 1st AF and others, 1 Apr. 1942; Orgn. Hist. 2d Photo. Gp. Rcn., 7 May 1942 to 31 Dec. 1942, p. 2; Hist. 3d AF, Flying Tng., 1941–1944, pp. 348, 356, 368.

37. Interview with Lt. Col. D. F. Tatum, WDGS OPD (formerly in charge of rcn. tng., A-3 Hq. 3d AF), 18 June 1946; interview with Lt. Col. John E. Murray, Policy and Tac. Employment Br., AC/AS-3, 13 June 1946; *The Army Officer*, Nov. 1942, p. 5; Hist. 3d Tac. Air Div., 1–31 Jan. 1945, pp. 7–9.

38. Hist. 3d AF, Flying Tng., 1941–1944, pp. 385–408; Hist. 3d Tac. Air Div., Sept. 1944, pp. 22–25; memo for Management Control from AC/AS OC&R, 12 Sept. 1944; Hist. Hq. 3d Tac. Air Div., 1–31 Jan. 1945, pp. 7–9; AAF tng. standards, series 30-; AAF Stat. Digest, table 52.

39. Hist. 3d Tac. Air Div. [monthly installments], May 1944–Aug. 1945; Orgn. Development of 1st AF, pp. 20–21; Hist. 2d AF, 7 Dec. 1941–31 Dec. 1942, p. 358; Hist. 3d AF, Flying Tng., 1941–44, pp. 370–75, 385; AAF tng. standards, series 30-.

40. Hist. 3d AF, Flying Tng., 1941–44, pp. 351–52, 356–57; Hist. 2d AF, 7 Dec. 1941–31 Dec. 1942, pp. 337–38.

41. Ltr., AAF to 3d AF, 21 July 1943; Tatum interview cited in n. 37.

42. Hist. 3d AF, Flying Tng., 1941–1944, p. 380; Tatum interview; memo for AC/AS OC&R from AC/AS Tng., 6 Sept. 1944.

43. Tatum interview; interview with Col. F. L. Dunn, A-2 Div., Hq. AAF, 17 June 1946.

44. Memo for C/S from Lt. Gen. L. J. McNair, 23 Mar. 1943; memo for C/S from AC/AS Tng., 20 May 1943, with incl.; Rpt. of Rcn. and Photo Bd. Sub-Board to AAF Bd., Sch. Applied Tactics, 8, 9, 19 June 1943; Reg. 50-4, Hq. 89th Rcn. Tng. Wing, Will Rogers Fld., 1 June 1944; ltr., AAF to 3d AF, 28 Nov. 1944.

45. R&R, AC/AS OC&R to AC/AS Tng., 30 Nov. 1944; Hq. 75th Tac. Rcn. Gp. Tng. Program, Key Fld., Miss., 20 Jan. 1944; off. CO Key Fld., memo 50-3, 13 Sept. 1944; AAF Tng. Standard 20-2A, 28 Feb. 1944; Tatum interview.

46. Outline Hist. I TCC, 24 Sept. 1943, p. 1; Brief Hist. I TCC, Accomplishments and Commitments, 21 Dec. 1943, p. 1; interview with Lt. Col. F. K. McMahon, TC Br., AC/AS Tng., 28 May 1945.

47. Interview with Lt. Col. McMahon, 11 May 1945; memo for C/AS from AC/AS Tng., 28 June 1944; CAF GO 9, 16 Apr. 1945.

48. AAF Stat. Digest, table 52; Hq. AFTRC, table, Glider Pilot Graduates, 1942–1945.

49. AAF tng. standards series 30-; memo for TAI from AC/AS Tng., 2 Jan. 1944, with incl.; memo for Lt. Col. W. E. Brown from DC/TC Br., AC/AS Tng., 28 Mar. 1944; CCTS Tng. Direc., C-46 Type a/c, I TCC, 9 Feb. 1945.

50. 3d ind. (ltr., AAF to I TCC, 30 Aug. 1943), TCC to AAF, 14 Nov. 1943.

51. Ltr., AAF to I TCC, 20 Sept. 1943, with incl.; ltr., I TCC to AAF, 1 Jan. 1944; ltrs., AAF to I TCC, 19 Aug. 1944, 20 Sept. 1944; memo for AC/S G-3 from Actg. DC/AS, 11 Nov. 1943; memo, Daily Diary, for AC/AS Tng. from Unit Tng. Div., 14 May 1943; ltr., AAF to I TCC, 5 Aug. 1944, 1 Nov. 1944; McMahon interview, 11 May 1945; Hist. 63d TC Gp., 1 Dec. 1940–31 Dec. 1943, pp. 8–9, 12.

52. Tng. Direc., Glider Tng. CCTS, I TCC, 19 Mar. 1945; ltrs., AFTRC to Pres. AAF Bd., 3 Oct. 1944; AAF to AFTRC, 23 Nov. 1944; Hist. CFTC, 1 Jan. 1943–31 Dec. 1943, IV, 896; interview with Maj. E. L. Brown, A-3 Div., Hq. AFTRC, 5 June 1945; AHS-1, The Glider Pilot Training Program, 1941–1943, pp. 4, 58, 65; TC Memo 50-4-1, 1 Aug. 1943, 21 Mar. 1944; Glider Pilot Tng., *Army and Navy Register*, 20 Jan. 1945, p. 6.

53. Ltr., 374th TC Gp. to 5th AF, 17 Apr. 1945; memo for TAI from Unit Tng. Div., AC/AS Tng., 23 Mar. 1944; ltr., AC/AS Tng. to I TCC, 4 Jan. 1944, with incl.; memo for C/AS from 9th AF, 14 Jan. 1944; memo for AC/AS OC&R from AC/AS Tng., 19 Aug. 1944; ltr., AC/AS Tng. to I TCC, 15 Sept. 1944.

54. AHS-28, Development of Administrative Planning and Control in the AAF, chart following p. 58.

55. Chester Wardlow, *The Transportation Corps: Responsibilities, Organization, and Operations,* U.S. Army in World War II (Washington, 1951), pp. 95–111, and table, p. 110.

56. Hist. First Air Force: Movements to Combat from the First Air Force, 1941–1943, Vol. III, Pt. 10, pp. 80–82.

57. *Ibid.,* pp. 86–87.

58. Wardlow, *The Transportation Corps,* pp. 51–53.

59. Hist. First Air Force, 1941–43, Vol. III, Pt. 10, pp. 39–52.

60. *Ibid.,* pp. 27–34, 52–53.

61. Hist. AAF Overseas Replacement Depot, Kearns, Utah, 1 July 1944 to 30 Sept. 1944, I, 7; *ibid.,* 1 Oct. 1944 to 31 Dec. 1944, I, 2; *ibid.,* 1 Jan. 1945 to 31 March 1945, I, 1–2.

62. Hist. AAF Overseas Replacement Depot, Greensboro, N.C., pp. 182–86.

63. *Ibid.,* pp. 190–212.

64. *Ibid.,* pp. 169–70.

65. Hist. First Air Force, 1941–43, Vol. III, Pt. 10, pp. 83–86; AFTRC Headquarters Progress Report, May 1944, p. 25.

66. AFTRC Hq. Prog. Rpt., Jan. 1944, p. 5; *ibid.,* Aug. 1944, p. 18; *ibid.,* Mar. 1945, p. 16; Hist. AAF Tng. Comd., Jan.–Apr. 1945, I, 15.

NOTES TO CHAPTER 19

1. Calculations based upon AAF Stat. Digest, tables 6–7.

2. Chart, Tech. Tng. Graduates by Specialty, in Hist. AAF Tng. Comd., 1 Jan. 1939 to V-J Day, p. 1406.

3. Hist. Chanute Fld., 1 Jan. 1939–7 Dec. 1941, I, 49; Hq. AAF Tng. Rpt.–Tech. Tng., 31 Dec. 1942; Hq. AAF Tech. Tng. Rpt.–Factory Tng. Program, 31 Dec. 1943; Brig. Gen. R. W. Harper to CG AFTTC, 15 Dec. 1942; SCD, Off. Management Control, monthly tng. rpts.; interview, Capt. H. C. Freeman, 14 Aug. 1944.

4. AAFTTC to 4th Dist., TCC, 18 June 1943, in Hist. AAF Tng. Comd., p. 1401.

5. AAF to AAFTTC, 1 Apr. 1942; Keesler Fld., Miss., to AFTRC, 30 Oct. 1944; Hist. Amarillo AAF, Texas, May–June 1945, I, 148.

6. AAF to ACTTC, 29 Apr. 1942; AAFTTC to 3d Dist., TTC, 25 May 1942; Hist. 4th Dist., TTC, 10 Mar.–31 Dec. 1942, I, 122–23, 166–67; TC Memo 50-22-8, 13 Mar. 1944.

7. Hist. AAF Tng. Comd., pp. 1429–31.

8. TC Memo 50-32-4, 8 July 1944.

9. TC Memo 50-32-3, 3 Jan. 1944; Syllabus for Airplane Hydraulic Spec. Course, Chanute Fld., 1 Mar. 1944; Syllabus of Instr., Adv. Propellers, Chanute Fld., 2 Apr. 1943.

10. Chanute Fld. to CTTC, 5 Nov. 1943; TWX, AFTRC to ETTC, 16 Aug. 1943; AFTRC to ETTC, 9 Feb. 1945.

11. Histories, Chanute Fld., Nov.–Dec. 1944, II, 305–8; May–June 1945, I, 178–82; 1 July–31 Aug. 1945, I, 160–62; Histories Sheppard Fld., Texas, 1 May–30 June 1945, I, 262–67; 1 July–30 Aug. 1945, I, 251–55.

12. Maj. Gen. W. H. Frank, CG AFASC to CG AAF, 8 May 1943; CG AFTRC to CG AAF, 19 Nov. 1943; Daily Diary, Hq. AFTRC, 23 Nov. 1943, in AHS-26, Individual Training in Aircraft Maintenance in the AAF, pp. 15, 74; ATSC, Hist. Procurement and Tng. of Civ. Pers. (ASC), Pt. I, 1939 thru 1941, pp. 7–27; Pt. II, 1942, pp. 29–134.

13. Program of Tng. . . . 3d Ech., Ohio Institute of Aeronautics, Columbus, Ohio; Syllabus of Instr. for A/C Engine Overhaul Mechanics . . . , Hq. AAFTTC, in Hist. AAF Tng. Comd., pp. 1412–44.

14. Histories, Chanute Fld., 7 Dec. 1941–1 Jan. 1943, II, 343–45; 1942, II, 352–62, 368–69; Jan.–July 1943, I, 130–35; July–Dec. 1943, I, 117, 134–35, 139–40; 2 Jan.–29 Feb. 1944, I, 95; July–Aug. 1944, I, 29, 37; Jan.–Feb. 1945, II, 299–300.

15. Histories, Chanute Fld., 1942, II, 372–75; Jan.–Feb. 1945, II, 301; Mar.–Apr. 1945, I, 201; AAF to AFTRC, 30 Jan. 1945; Hist. Buckley Fld., Colo., 1 Jan.–7 July 1943, I, 43–44; Outline of Instr., Arctic Tng. Div., Buckley Fld., 20 Apr. 1944; WTTC to AFTRC, 10 Aug. 1944; AAF to AFTRC, 29 Aug. 1944.

16. AAF to AFTRC, 10 July 1944; AFTRC to ETTC, 8 Feb. 1945.

17. For this discussion see AAFTTC to 1st Dist., TTC, 18 Aug. 1942; AAFTTC

to 1st Dist., TTC, 14 Sept. 1942; Hist. 4th Dist., TTC, 10 Mar. 1942–31 Dec. 1942, I, 73–77, 87; WTTC to AFTRC, 15 Aug. 1944; 1st Dist., TTC to AAFTTC, 4 Jan. 1943.

18. Hist. AAF Tng. Comd., pp. 1494–1501.

19. Hist. Radio Schs., Scott Fld., Ill., 1 Jan. 1939–7 Dec. 1941, p. 1; Hist. 2d Dist., TTC, 1 Jan. 1939–7 Dec. 1941, pp. 25, 53, 67, 70; 7 Dec. 1941–31 Dec. 1942, pp. 1, 151–52; Hist. Scott Fld., Ill., 1 Jan. 1939–7 Dec. 1941, pp. 35–36, 43, 48–50; Radio and Radar Supply, Maintenance, and Training by the Air Service Command, pp. 84–115; AAF Stat. Digest, table 50.

20. Hist. Scott Fld., 1 Jan. 1939–7 Dec. 1941, pp. 43–47; Hist. Truax Fld., 1 Jan.–7 July 1943, p. 356; Hist. Tech. Sch., Tomah, Wisc., 5 Nov.–31 Dec. 1942, pp. 9–12, 20, 30–34.

21. Hist. 2d Dist., TTC, 7 Dec. 1941–31 Dec. 1942, IV, 1013, doc. 201; Histories, Scott Fld., 7 Dec. 1941–31 Dec. 1942, pp. 36–37; Jan.–July 1943, pp. 27–28; July 1943–Mar. 1944, pp. 560–62.

22. Hist. Truax Fld., Wisc., 12 Apr.–31 Dec. 1942, pp. 115, 132; 1 Jan.–1 Mar. 1944, pp. 118–19; Histories, Chanute Fld., 7 Dec. 1941–1 Jan. 1943, pp. 406–8; 8 July–31 Dec. 1943, p. 223; Hist. 2d Dist., 1 Jan.–7 July 1943, pp. 352–53; Hist. Scott Fld., 1 May–30 June 1944, pp. 136–37.

23. Hist. Scott Fld., Jan.–July 1943, pp. 104–5; Histories, Dept. of Comm., Yale Univ., 8 Dec. 1942–31 Dec. 1942, pp. 5, 14–15; 1 Nov. 1944–31 Jan. 1945, p. 102; Hist. Chanute Fld., 1 July–31 Aug. 1944, pp. 102–4.

24. Brig. Gen. Davenport Johnson to Brig. Gen. Rush B. Lincoln, 26 May 1941; Hist. Scott Fld., 7 Dec. 1941–31 Dec. 1942, p. 139; OCAC to ACTTC, 11 Dec. 1941; AAF Stat. Digest, tables 49, 50; Hist. Boca Raton AAF, Inception to 31 Dec. 1942, pp. 21–22.

25. Histories, Boca Raton AAF, 1 Jan.–7 July 1943, pp. 33–39; 7 July 1943–1 Mar. 1944, p. 45; 1 Mar.–30 Apr. 1944, pp. 45, 52; AFTRC to ETTC, 11 Mar. 1944; TC Memo 50-33-8, 18 July 1944, in Hist. AAF Tng. Comd., pp. 1516–18; Monograph on Comm. Tng., I, 106.

26. Hist. ETTC, 1 Mar. 1944–1 July 1944, p. 623; AFTRC to ETTC, 25 May 1944; AAF to AFTRC, 28 Sept. 1944; Hist. Langley Fld., 1 Nov. 1944–31 Dec. 1944, pp. 106–7, 149–53, 164–65; Hist. AAF Tng. Comd., p. 1522.

27. Histories, Chanute Fld., 7 Dec. 1941–31 Dec. 1942, II, 415–22; 7 July–31 Dec. 1943, I, 205–8; 1 May–30 June 1945, I, 142–43; Hist. 2d Dist., 1942, I, 221–22; Hist. TS, Pawling, N.Y., 3 Nov. 1942–15 Sept. 1943, pp. 52–54, 56–59, 74–75; TC Memo 50-33-11, 10 Mar. 1945.

28. AHS-60, Individual Training in Aircraft Armament by the AAF, 1939–1945, pp. 1–2; AAF Stat. Digest, table 50.

29. AHS-60, pp. 37–38; Hist. Lowry Fld., Colo., 1942, II, chap. 5, pp. 10–11, 20, 76–78; AAF to AAFTTC, 17 July 1943; AFTRC to WTTC, 28 Aug. 1944; AFTRC to AAF, 30 Mar. 1944; AFTRC to WTTC, 31 Oct. 1944; AAF to AFTRC, 29 Mar. 1945.

30. Hist. Lowry Fld., 1942, II, chap. 5, pp. 199–228; Hist. 2d Dist., Jan.–July 1943, I, 260–61; AAFTTC to 4th Dist., AAFTTC, 7 Feb. 1943.

31. Hist. Lowry Fld., 1942, II, chap. 5, p. 151; AAF to AAFTTC, 11 May 1943; AHS-60, pp. 62, 71.

32. AHS-60, pp. 16–17, 50–54, 57–59.

33. *Ibid.*, pp. 72–85; Hist. Lowry Fld., 1942, II, 116, 125, 149–50; 2d ind. (4th Dist., TTC to TTC, 1 July 1942), AAF to TTC, 11 Aug. 1942; Hist. TS, Yale Univ., 1 July–31 Aug. 1944, p. 85; AAF to TTC [*ca.* 31 May 1943] and 17 July 1943, in Hist. AAF Tng. Comd., pp. 1545–49.

34. AAF Stat. Digest, table 50.

35. Memo for C/S AAFTTC from Hq. AAFTTC, 15 Dec. 1942; AAF to AAFTTC, 16 Jan. 1943; AAFTTC to AAF, 19 Dec. 1942; AAF to AFTRC, 14 Oct. 1943; Histories, Lowry Fld., July–Dec. 1943, II, 15; 1 Jan.–30 June 1944, II, 24; May–June 1945, II, 139; AFTRC to WTTC, 3 July 1944.

36. Histories, Lowry Fld., 1939–1941, II, 34, 38; 1942, II, 19–21, 24; Hist. TS. Yale Univ., 8 July 1943–1 Mar. 1944, p. 145.

37. OCAC to Scott Fld., Ill., 22 May 1939; Hist. TS, Grand Rapids, Mich., 21 Nov.–31 Dec. 1942, I, 299; Hist. CTTC, 7 July 1943–1 Mar. 1944, I, 159,

318–19; *Official Guide to the AAF*, p. 354; AAF Stat. Digest, table 50.

38. Program of Instr. for EM's Courses, Chanute Fld., 1940–1941, in Hist. AAF Tng. Comd., pp. 1576–77.

39. Chanute Fld. to OCAC, 8 Apr. 1941; Hist. 2d Dist., TTC, 7 Dec. 1941–31 Dec. 1942, III, doc. 184; Program of Instr., Enlisted Weather Forecasting Course, Chanute Fld. [effective Feb. 1943], in Hist. AAF Tng. Comd., pp. 1567, 1572–74.

40. AAF to AAFTTC, 12 Jan. 1943; Program of Instr., AAFTTC Weather Training Program, Class "B" Meteorology, [date unknown], in Hist. AAF Tng. Comd., pp. 1591–93, 1598–1612.

41. Rpt. on Flying Cadets (Non-Pilot—Meteorology), [date unknown]; Hist. 3515th AAFBU, MIT, 7 July 1943–20 June 1944, p. 33; AAF to Weather Wing, AAF Flight Control Comd., Asheville, N.C., 24 June 1943; AAF to AFTRC, 25 Oct. 1944; AAF Ltr. 50-76, 6 Dec. 1944; Hist. Chanute Fld., Mar.–Apr. 1945, p. 316.

42. AAF to AFTRC, 26 Jan. 1945; Hist. Chanute Fld., 1 Mar.–30 Apr. 1945, II, doc. 184; Hist. ETTC, 1 May–1 July 1945, I, pp. 159–60.

43. Hist. AAF Tng. Comd., pp. 1568–71, 1578–82, 1587–91.

44. Gen. H. H. Arnold to all personnel of the AAF, 6 Nov. 1943; AAF Reg. 35–57, 9 Apr. 1945; AR 605–145, 14 June 1945; AR 615–200, 15 Mar. 1943; memo for CG's AGF, AAF, SOS from S/W, sub.: Responsibility for training, 30 May 1942; memo for TAG from S/W, sub.: Arms and Services with the Army Air Forces, 20 Oct. 1942; interview, Dr. Boyd Shafer, WDSS, 31 Mar. 1947; AAF Stat. Digest, tables 18, 23.

45. Hist. 2d Dist., TTC, 1942, II, 349; Hist. 1st Dist., 1 Jan.–7 July 1943, I, 339–40; AAF to AAFTTC, 19 June 1943; Brig. Gen. S. C. Godfrey, Air Engr., Hq. AAF to Maj. Gen. W. R. Weaver, 30 June 1943; Weaver to Godfrey, 8 July 1943; interview, Lt Col. Raymond S. Sleeper, Hq. AAF, 2 Apr. 1946; Hist. Jefferson Barracks, 8 July 1943–29 Feb. 1944, I, 152.

46. Lt. Col. C. L. Beaven, Chronological Hist. Avn. Medicine, pp. 17–21; Annual Rpts. Sch. Avn. Medicine (1943), p. 16; (1944), pp. 5–19, 36.

47. Annual Rpt. Sch. Avn. Medicine (1944), p. 9; Annual Rpt. Off. TAS (1942), pp. 14–15; AAF Regs. 20-22, 22 July 1943; 20-27, 4 Dec. 1944; 2d ind. (AAF to CFTC, 2 May 1945), AFTRC to AAF, 23 May 1945.

48. Hist. AAF Medical Service Tng. Sch., pp. 2–9, 13, 57–58, 116, 120, 122; AAF Reg. 20-28, 12 Nov. 1943 and 17 Oct. 1944.

49. AAF to AFTRC, 31 Mar. 1944; Hist. San Antonio Aviation Cadet Center, Texas, 1 May–30 June 1944, p. 32; AAF to Air Forces and Comds., 3 April 1944; Avn. Engr. and Signal Avn. Unit Tng. in 4th AF, 1941–1945, I, pp. 86–91.

50. Hist. Lowry Fld., Mar.–Apr. 1945, II, 223; Hist. Buckley Fld., May–June 1945, I, 71, 124; Buckley Fld., to WTTC, 15 June 1945; AFTRC to ETTC, 24 Oct. 1945; AAF Ltr. 50-9, 21 Feb. 1945; memo for AC/AS Tng. from Maj. F. S. Swackhamer, 29 Sept. 1943.

51. Hist. Lowry Fld., Mar.–Apr. 1945, II, 200; Histories, Buckley Fld., May–June 1945, I, 76–79; July–Aug. 1945, I, 144, 154; AAF to AFTRC, 31 Mar. 1944.

52. Hist. Lowry Fld., 1 Mar.–30 Apr. 1945, II, 212–14; Hist. Buckley Fld., 1 May–30 June 1945, I, 83–92, III, docs. 50–51; TC Memo 50-26-4, 12 June 1945; AAF to AFTRC, 2 Feb. 1945; AFTRC to AAF, 11 May 1945; TC Memo 50-26-16, 3 Nov. 1945.

53. EFTC Cir. 33-0, 4 Apr. 1945; EFTC to AFTRC, 7 Nov. 1945; TC Memo 33-3, 7 Aug. 1945; AFTRC to ETTC, 30 Oct. 1945; AAF Ltr. 50-153, 8 Nov. 1945; AFTRC to AAF, 10 Oct. 1945.

54. Hist. AAF Tng. Comd., p. 1714; Westover AAB, Mass., to Ordnance Off., I FC, 5 Mar. 1943; I FC to Air Forces, EDC and FAF, 7 Mar. 1943; 1st AF to Selfridge AAB, 29 Mar. 1944, in Hist. 1st AF, Arms and Services Tng., Feb. 1941–Dec. 1944, pp. 63–68.

55. Lt. Gen. H. H. Arnold to Maj. Gen. W. R. Weaver, 13 Aug. 1942; Weaver to Arnold, 17 Aug. 1942; AAFTTC to AAF, 11 Aug. 1942.

56. AAFTTC to 1st Dist., AAFTTC, 28 Sept. 1942, 3 Nov. 1942; AAFTTC to 2d Dist. AAFTTC, 16 Oct. 1942; Rpt., Tech. Tng. Conf., 5 July 1943.

57. AAFTTC to 5th Dist., AAFTTC, 24 Apr. 1943; AAFTTC to 4th Dist.,

AAFTTC, 18 June 1943; Sum. Remarks, Maj. Gen. W. R. Weaver to officers of G-3 Div., AAFTTC, 6 Apr. 1943.

58. Histories, 2d Dist., AAFTTC, 7 Dec. 1941–31 Dec. 1942, p. 323; 1 Jan.–7 July 1943, pp. 534–35; Hist. Scott Fld., 1 Jan.–7 July 1943, pp. 29, 43–44; Histories, 4th Dist., AAFTTC, 10 Mar.–31 Dec. 1942, pp. 146–47; 1 Jan.–7 July 1943, p. 165; Hist. 1st Dist., AAFTTC, 10 Mar.–31 Dec. 1942, p. 389; Hist. AAF Weather Tng. Ctr., 1 Jan.–15 Oct. 1943, p. 263; Hist. 2d Dist., 1 Jan.–7 July 1943, pp. 366–67.

59. Hist. CTTC, 7 July 1943–1 Mar. 1944, V. 242–43, doc. 169; TC Memo 50-33-1, 25 Oct. 1943; Hist. Keesler Fld., 1 Jan.–28 Feb. 1945, pp. 573–75.

60. TC Memo 50-31-1, 25 Oct. 1943; Hist. 1st Dist., TTC, 1 Jan.–7 July 1943, II, 682–84; Min. Dist. Comdrs. Conf., AAFTTC, 5–6 Aug. 1942, p. 58; AAF to AAFTTC, 24 Sept. 1942; AAFTTC to 1st, 2d, 3d, and 4th Dists., TTC, 31 Oct. 1942; AAFTTC to 4th Dist., TTC, 21 Nov. 1942; [AAF] to AAFTTC, 19 Dec. 1942; Hist. ETTC, Nov. 1944–Jan. 1945, I, pp. 89–93.

61. Hist. WTTC, July–Dec. 1943, II, 940–42; Hist. CTTC, July 1943–Mar. 1944, I, 227–29; AFTRC to ETTC, 14 Jan. 1944; ACTTC to ACTS, Keesler Fld., Miss., 14 Apr. 1942; AAFTTC to 3d Dist., TTC, 31 May 1942; AAFTTC to 4th Dist., TTC, 17 July 1942; AAFTTC to 1st, 2d, 3d, and 4th Dists., TTC, 22 July 1942; AAFTTC to 1st Dist.. TTC, 10 Aug. 1942; TT Cir. 18, 7 Sept. 1942; Hist. ETTC, Sept.–Nov. 1944, II, 470–71; [AAFTTC] to 1st Dist., TTC, 10 Dec. 1942; AAF to AAFTTC, 6 Feb. 1943; memo for C/AS from Hq. AAF, Col. J. M. Bevans, 3 Apr. 1942; Hist. ETTC, Mar.–July 1944, VI, 23.

62. Testimony of Lt. Col. J. W. Hill, AGD, AAFTTC, Exhibit C, Bd. of Off. Mtg., Aug. 1942; 1st ind. (AAFTTC to AAF, 26 Aug. 1942), AAF to AAFTTC, 4 Oct. 1942; AAFTTC to BTC's, 11 Sept. 1942; AAF Manual 35-1, 3 Apr. 1944, pp. 31–33; interview, Dr. Boyd Shafer, WDSS, 31 Mar. 1947.

63. Hist. ETTC, 1 Sept.–1 Nov. 1944, II, 368–72; table, Percentage of Attrition from Tech. Tng. Courses [1939–1945]; Histories, Keesler Fld., 1942, II, 278; 8 July–31 Dec. 1943, II, 348; AR 350-110, C3, 2 Apr. 1943; TC Memo 35-55, 31 May 1945.

64. TC Memo 50-31-1, 25 Oct. 1943; Hist. CTTC, July 1943–Mar. 1944, V, doc. 169; memo for Brig. Gen. J. W. Jones, Actg. Exec. from Hq. AAFTTC, Lt. Col. C. L. Brownell, Div. Physical Fitness, 27 June 1942; Histories, 2d Dist., 7 Dec. 1941–31 Dec. 1942, I, 253; 1 Jan. 1943–7 July 1943, II, 354–55; TC Memo 35–37, 10 May 1944; Hist. WTTC, 1 Mar.–30 Apr. 1945, I, 251–52.

65. The Air Force in Theaters of Opns.: Orgn. and Functions, chap. I, chart I; Hist. I TCC, IV, 1–7; Hist. 2d AF for 1944, III, 486–87; interview, Capt. A. L. Walker, AC/AS-3, 4 Apr. 1947; Ordnance Dept. Mobilization Tng. Program for Ord. Sec., Combat Sq. [1943].

66. Hist. 2d AF for 1944, III, 484–85, 487.

67. AAF to CG's 1st, 2d, 3d, 4th AF's and ASC, 24 Dec. 1942; AAF to CG's 1st, 2d, 3d, and 4th AF's and ASC, 31 Dec. 1942, in Hist. Hq. 3d AF, Activation to 30 June 1944, I, 480–81, 487–99; R&R, Orgn. and Tng., MM&D to Supply and Services, MM&D, 14 May 1943; R&R, AFRBS to AFDPU, 18 Sept. 1942, in The Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, 1942 to 1945, pp. 4–5; ASC Avn. Sq. Tng. Manual, 1944.

68. ASC, Serv. Gp. Tng. Manual, 1944, p. 26; Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, 1942 to 1945, pp. 176–77, 219–22.

69. Orgn. and Tng. of Serv. Units, pp. 178–83.

70. Hist. Hq. 3d AF from 1 July 1944 to 30 Sept. 1944, pp. 30–35; Hist. AAF Tng. Comd., p. 1711.

71. Brig. Gen. S. C. Godfrey, Air Engr. to CG AAF, Aviation Engineer Program, 25 Oct. 1943; memo for C/AS from Brig. Gen. S. C. Godfrey, Assignment and Basic Training of Aviation Engineers, 20 May 1943, in Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, pp. 183–86; Orgn. Development, Northeast Air Dist. and 1st AF, 19 Nov. 1940 to 31 Dec. 1943, p. 22.

72. [Hist. 1st AF, 1 Jan. 1939 to 2 Sept. 1945] Arms and Services, Feb. 1941 to Dec. 1944, I, 45–48, 75; Hist. 3d Engr. Avn. Unit Tng. Center, 18 Mar. 1943–1 May 1944, pp. 76–79.

73. [Hist. 1st AF] Arms and Services, Feb. 1941 to Dec. 1944, I, 53–57.

74. Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, pp. 187–88; Avn. Engr. and Signal Avn. Unit Tng. in the 4th AF, 1941–1945, I, 30.

75. [Hist. 1st AF] Arms and Services, Feb. 1941 to Dec. 1944, I, 59–60.

76. Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, pp. 188–93.

77. *Ibid.*, pp. 200–3; Hist. Hq. 3d AF, 1 July 1944–30 Sept. 1944, pp. 35–40.

78. Lt. Col. Joseph H. Bryson, Personnel and Training Activities of the Ordnance Section from 1 June 1942 thru 1 November 1943, in Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, pp. 203–9; interoffice memo for AFRBS by Air Ordnance Off., 1 Mar. 1943; memo for Dep. for Serv. Tng. from Maj. D. H. Williams, Jr., 17 Mar. 1944.

79. R&R Comment #3, AFRBS to ASC, 30 Oct. 1942; Hq. I ASAC to Tng. Divs., 1 Sept. 1942; Lt. Col. R. Slough, Hist. Rpt., QM Activities, ASC ATSC, 6 Mar. 1945, in Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, pp. 209–14; [Hist. 1st AF] Arms and Services, I, 24–35.

80. ASC Reg. 50–2, 22 Apr. 1942; Tng. Guide, Signal Sec., ASC, 1st issue, Nov. 1942; 2d issue, Jan. 1943; P&T Div. Cir. 50-100-2, 22 Jan. 1944, in Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, pp. 214–19.

81. 1st AF Cir. 50-23, 1 Dec. 1942; Hq. AF EDC 1st AF to Langley AAB, 11 Jan. 1943; Eastern Sig. Avn. Unit Tng. Ctr., Tng. Prog. Sig. Constr. Bn., Avn, 3 Apr. 1943, in [Hist. 1st AF] Arms and Services, I, 1–11.

82. Hist. AWUTC, 1 Jan.–1 Oct. 1943, I, sec. II, pp. 1–2, 11, sec. VI, p. 1, 1 Jan.–20 Feb. 1945; II, sec. IV, p. 39; Hist. 3d AF, Activation to 30 June 1944, I, 142.

83. Hist. 1st AF, pp. 76–85.

84. *Ibid.*, pp. 92–95; Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, plate IX.

85. Avn. Engr. and Sig. Avn. Unit Tng. in 4th AF, 1941–1945, I, 76–85, 92–112.

86. Daily Diary, 3d AF, 25 July 1944; memo for Col. T. J. Dubose from Dep. for Serv. Tng., 8 Aug. 1944; Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, pp. 219–22.

87. Orgn. and Tng. of Tac. Serv. Units, pt. I, 1935–1942, pp. 167–72.

88. *Ibid.*, pt. II, 1942–1945, pp. 5-8, 28–45.

89. *Ibid.*, pp. 46–58.

90. *Ibid.*, pp. 125–27; [ATSC], Hist. Supply, Maint., and Tng. for the B-29, p. 89.

91. For the following discussion see Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, pp. 128–75; Air Depot Gp. Tng. Manual, 30 Aug. 1944; Serv. Gp. New Type Tng. Manual, 23 May 1944.

92. Hist. Supply, Maint., and Tng. for the B-29, pp. 88–96; Orgn. and Tng. of Tac. Serv. Units for Overseas Air Forces, pt. II, p. 219.

93. Orgn. and Tng. of Tac. Serv. Units, pp. 291–93.

94. [ATSC] Hist. Army Aircraft Repair Ship Project, Nov. 1943–Sept. 1944, pp. 1–4, 60–82.

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1. The Origins of the Ferrying Division, I, 11–12; Procurement and Training of Pilots in the Ferrying Div., ATC, May 1941 to Sept. 1945, I, 1–9 [hereinafter cited Procurement and Training of Pilots].

2. Procurement and Training of Pilots, I, 21, 26–27, 104.

3. *Ibid.*, I, 318–21; Hist. Rcd. Rpt., Domestic Trans. Div., ATC, 15 Mar. 1943–1 Apr. 1944, pp. 42–52.

4. Procurement and Training of Pilots, I, 328–31.

5. *Ibid.*, I, 11, 15, 18, 184–97; Origins of the Ferrying Division, ATC, pp. 80, 140, 544–50.

6. Procurement and Training of Pilots, I, 209–20, 307–8; Hist. 557th AAFBU, Great Falls, Mont., pp. 174–76.

7. Procurement and Training of Pilots, I, 221–30.

8. *Ibid.*, I, 240–42, 272–73.

9. *Ibid.*, I, 243–63.

10. *Ibid.*, I, 284–306.

11. *Ibid.*, I, 328–31, 370–74, 383–94; Hist. Domestic Trans. Div., ATC, 15 Mar. 1934–1 Apr. 1944, pp. 62–63.

12. Procurement and Training of Pilots, I, 423–40.

13. *Ibid.*, I, 441–48, 457–70.

14. *Ibid.*, I, 475–77, 481–82, 512–16.

15. Ltr., 2d OTU to all student pilots, 28 Feb. 1944; Hq. FERD, Tng. and Pers. Conf., 14–16 Jan. 1944, Summary of Results, both cited in Procurement and Training of Pilots, I, 480–81, 490–91, 506–8.

16. Ltr., Jacqueline Cochran to Mrs. F. D. Roosevelt, 28 Sept. 1939; *New York Times*, 11 Sept. 1942; ltr., Nancy H. Love to Lt. Col. Robert Olds, 21 May 1940; ltr., Cochran to Col. Olds, 21 July 1941; memo for Gen. Arnold from Gen. H. L. George, 12 Sept. 1942, all cited in Women Pilots with the AAF, 1941–1944, pp. 2–4, 5–6, 17.

17. *New York Times*, 11 Sept. 1942; memo for CG AAF from Col. L. S. Smith, 15 Sept. 1942; ltr., Maj. Gen. G. E. Stratemeyer to CG AFFTC, 7 Oct. 1942; Gen. Arnold to CG AFFTC, 3 Nov. 1942; R&R, Arnold to Stratemeyer, 6 Nov. 1942, all cited in Women Pilots with the AAF, pp. 17, 19–25.

18. Women Pilots with the AAF, pp. 25–30.

19. *Ibid.*, pp. 31–34.

20. *Ibid.*, pp. 37–43, 60–67, 103–4.

21. Hist. 5th Dist., TTC, Vol. II; Hist. AAF OCS, 19 Feb. 1942–25 July 1943, pp. 3–4; Air Corps OCS GO 2, 21 Feb. 1942; Hist. CFTC, 1 Jan.–30 June 1944, V, 892; Hist. CFTC, 1 May–30 June 1945, III, 439; ltr., AAF to AFTRC, 18 Aug. 1945; Rpt., Tng. Status of AAF Personnel, AAF-SC-T19, Hq. AFTRC, all cited in Hist. AAF Tng. Comd., 1 Jan. 1939–V-J Day, VIII, 1643–45.

22. Ltrs., AAF to C/AC, 17 Feb. 1942, 13 May 1943; AAF to AFTRC, 26 June 1945; TWX, AFTRC to Fort Worth AAF, 30 June 1945, all cited in Hist. AAF Tng. Comd., VIII, 1659–63.

23. IOM, ACTTC, 28 Feb. 1942; ltr., Hq. AAF to all air forces, 18 Feb. 1943; ltr., Hq. Miami Area, 1st Dist., TTC to AAFTTC, 9 July 1942; Hist. AAF OCS, Feb. 1942–July 1943, II, 111, all cited in Hist. AAF Tng. Comd., VIII, 1661–62.

24. Hist. AAF OCS, Feb. 1942–July 1943, pp. 99, 120, 143–45, and 7 July 1943–1 Mar. 1944, pp. 88–89, all cited in Hist. AAF Tng. Comd., VIII, 1645–50.

25. Interviews with Capt. W. H. Dusenberry, Capt. T. H. Greer, 1st Lt. M. L. Tartaglia, former students at OCS, 2 Nov. 1945; ltr., AAF to AFTRC, 19 Apr. 1944; Hist. AAF OCS, Feb. 1942–July 1943, p. 131, all cited in Hist. AAF Tng. Comd., VIII, 1650–51, 1666–68.

26. Hist. AAF OCS, Feb. 1942–July 1943, p. 57; Dept. of Tng., AAF OCS, A Manual for Tactical Officers, 15 May 1942; Wing Tips, Official Handbook of the Corps of Air Forces Officer Candidates, all cited in Hist. AAF Tng. Comd., VIII, 1653–56.

27. Hist. AAF Tng. Comd., VIII, 1656–57.

28. AAF to AAFTTC, 2 June 1943; Hist. AAF OCS, 1 Mar.–1 July 1944, p. 55; Hq. AFTRC, A-3 Div., special study, all cited in Hist. AAF Tng. Comd., VIII, 1664–66.

29. Ltr., AAF to ACTTC, 6 Apr. 1942; OCS, AAFTTC GO 14, 23 June 1942; Hist. 5th Dist., TTC, Vol. III, Hist. AAF OTS, 18 Apr. 1942–26 June 1943, p. 7, plate XII following p. 65, all cited in Hist. AAF Tng. Comd., VIII, 1671–73, 1677–78, 1680.

30. Memo for Maj. Gen. Stratemeyer from Col. Don Z. Zimmerman, 27 June 1942; R&R, AFACT to AFCAS, AFACT, AFRIT, 4–30 July 1942; AGO ltr., 27 Oct. 1942, all cited in Hist. AAF School, 29 Oct. 1943–2 Sept. 1945, I, 1–3.

31. Hist. AAF School, I, 4–7; Training and Testing at AAFSAT, Nov. 1942 to Oct. 1943, Bombardment, I, 99–101, 133–35.

32. Hist. AAF School, I, 7–16.

33. *Ibid.*, I, 100–12.

34. *Ibid.*, I, 121–77.

35. *Ibid.*, I, 39–49.

36. *Ibid.*, I, 50–85, table II following p. 189; interview, Dr. R. F. Futrell, formerly Hist. Off., AFTAC, 11 June 1947.

37. Directive, Comdt. AAFSAT to C/Bomb. Dept., 21 Nov. 1942; ltr., C/Strat. Bomb. Sec. to Comdt. AAFSAT, 13 Apr. 1944; AAFTAC Manual, VHB Cadre Tng., all cited in Hist. AAF School, II, 33–48.

38. Hist. AAF School, II, 101–21, 163–70.

39. *Ibid.*, II, 190–95.

40. *Ibid.*, II, 196–202, 204–8.

41. Memo for Maj. A. A. Houghton from Capt. F. W. Galbraith, 25 May 1944, in Hist. AAF School, II, 219–22.

42. 3d Bomb. Div., 8th AF, Group S-2 Manual, 10 Nov. 1943; personal observations, Lt. W. A. Walsh, Hist. Off., AAF Special Staff Sch., Orlando, Fla.; discussion in S-2 office, 96th Bomb. Gp., 24 Aug. 1943, with Maj. Reynolds Benson, Capt. Jesse S. Plummer, Capt. Paul L. Doyle, *et al.*, all cited in Hist. AAF School, II, 227–29.

43. Hist. AAF School, II, 229–31.

44. Ltr., Brig. Gen. T. M. White, AC/AS Intel. to Comdt. AAFAIS, 22 Feb. 1944; ltr., AC/AS OC&R to AFCTR, 3 Oct. 1944, both cited in Hist. AAF School, II, 231–42.

45. Hist. AAF School, II, 244–49.

46. *Ibid.*, II, 3–4, 15–32.

47. Academic Training Memo 5, Hq. AAFSAT, 22 May 1943; Training Memo 1, Hq. AAFSAT, 22 Jan. 1944, both cited in Hist. AAF School, II, 1–7.

48. Ltr., AAF to Comdt., AAFSAM, 11 Apr. 1944; ltr., AAF to D/Aero Medical Dept., AAFSAT, 11 Apr. 1944, both cited in Hist. AAF School, II, 7–9.

49. Info. and Regs., Army and Navy Staff College, 1 Sept. 1944; Prospect Dep. Comdt., ANSCOL to Distrib. List, 15 May 1943; Scope of Instr. at the Army and Navy Staff College and Associated Schs., [n.d.]; interview with Maj. J. A. Bloomer, Course Director, ANSCOL, 6 Dec. 1945, all cited in Hist. AAF School, II, 126–30.

50. Hist. AAF School, II, 134–37.

51. *Ibid.*, II, 137–39.

52. Ltr., AC/AS OC&R to AAFSAT [*ca.* 1 July 1943]; Comd. and Staff Sec., AAF School, Hist. AAF Staff Officers' Course; ltr., AC/AS Training to Air Forces Staff Course, AC/AS Personnel, 17 Aug. 1943, all cited in Hist. AAF School, II, 131–34.

53. Hist. AAF School, II, 171–89.

54. 52 *Stat.* 1034; Exec. Order 7964, 29 Aug. 1938 (3 CFR Supp. 389), cited in AHS-64, Training of Foreign Nationals, 1939–1945, pp. 2–3, 105.

55. 55 *Stat.* 31, cited in AHS-64, pp. 4, 105.

56. See AHS-64, pp. 4–5, 105, for memo for US/W from Col. F. L. Llewellyn, Asst. JAG, 13 Oct. 1941, quoting the Attorney General.

57. *Ibid.*, p. 5.

58. *Ibid.*, p. 6.

59. *Ibid.*, pp. 8–10, 106.

60. Notes of a mtg. held in London on 13 Apr. 1941 to discuss flying tng. facilities in the U.S.; memo for C/S from Maj. Gen. G. H. Brett, Actg. C/AC, 6 May 1941; memo for Maj. Gen. G. H. Brett from Brig. Gen. Davenport Johnson, 3 June 1941; Hist. AAF Flying Tng. Comd., 1 Jan. 1939–7 Dec. 1941, pp. 562–67; memo for Maj. Gen. G. H. Brett from Col. W. F. Kraus, Exec. T&O Div., 8 May 1941; memo for Gen. Brett from Col. W. F. Kraus, 10 May 1941; Hist. AAFFTD, Pan-American Airways, Inc., 1 Aug. 1940–1 Mar. 1944, all cited in AHS-64, pp. 11–13, 106–7.

61. Ltr., AM D. C. S. Evill, BJSM, Washington to Gen. H. H. Arnold, 8 July 1942; ltr., AAF to AAFTC, 3 July 1942, both cited in AHS-64, pp. 13–16, 107.

62. AHS-64, p. 22 and appendixes.

63. *Ibid.*, pp. 19–21, 108.

64. Ltr., Col. W. R. Taylor, CO 26th Ftr. Comd. to CG 6th AF, 20 Dec. 1943; ltr., Lt. Col. G. A. Braga for Sec. AC/AS Training to the Sec. of State, 7 Aug. 1944; memo for CG AAF from Maj. Gen. G. V. Henry, Joint Mexican-U.S. Defense Commission, 12 Dec. 1944, all cited in AHS-64, pp. 21, 109.

65. AHS-64, p. 22 and appendixes.

66. Rpt. of Brig. Gen. H. B. Claggett on the Air Mission to China, Ser. 26, Intel. Div., O/CNO, 28 July 1941; ltr., Gen. G. C. Marshall, C/S to Dr. Laughlin Currie, 15 July 1941; Hist. 8th Group, Chinese AF, p. 1; Hist. WCTC, 7 Dec. 1941–31 Dec. 1942, doc. XVI, 1; ltr., Maj. Gen. H. H. Arnold to Dr. Laughlin Currie, 27 Apr. 1942; incl. to memo for Brig. Gen. W. W. Welsh, AC/AS Training from Lt. Col. G. A. Braga, 2 Nov. 1944, all cited in AHS-64, pp. 23–30, 109–10.

67. Ltr., Maj. Gen. L. H. van Oyen to Col. H. A. Johnson, G-2 Div., Hq. AFFTC, 29 May 1942; ltr., AFFTC to AAF, 23 Jan. 1943; Hist. EFTC, 1 Jan.–31 Dec. 1943, p. 1002; all cited in AHS-64, pp. 30–33, 110; U.S. Strategic Bombing Survey, Air Forces Allied with the United States in the War against Japan (Feb. 1947), pp. 11–13; Hist. Royal Netherlands Military Flying School, Jackson, Miss., 1942–1943.

68. AHS-64, pp. 33–39, 111; cable msg., Maj. Gen. C. A. Spaatz to CG AAF, 29 Dec. 1942; AAF to AFFTC, 26 Feb. 1943; memo for C/AS from AC/AS Training, 10 July 1943; memo for James F. Byrnes, Sec. of State, from President Truman, 5 Dec. 1945.

69. AHS–64, pp. 39–44, 111, appendixes.

70. Ltr., Lt. Col. E. G. Reinartz, Comdt. SAM, Randolph Fld. to Air Surgeon, 25 Feb. 1942; ltr., Capt. J. D. Landauer, Asst. Exec., SAACC to CG GCTC, 4 June 1943; ltr., OCAC to SETC, 15 May 1941; ltr., Lt. Col. H. Y. Lai, CO Chinese Avn. Students in U.S. to CG CFTC, 2 Apr. 1945; ltr., EFTC to CO's of AAF schools training French students, 1 Sept. 1944; Hist. AFFTC, 1 Jan. 1939–7 July 1943, p. 2175, all cited in AHS-64, pp. 63–66, 116.

71. Notes on mtg. held in AC/AS Plans, Western Hemisphere Br., 4 Apr. 1944; ltr., Maj. Christy Mathewson, D/Pilot Tng., Glendale, Ariz., to CG AAF thru WFTC, 29 Oct. 1943; Hist. EFTC, 1 Jan.–31 Dec. 1943, pp. 1016–17; Hist. WFTC, 7 Dec. 1941–31 Dec. 1942, p. 512; ltr., Maj. Gen. Charles Luguet, C/French Air Mission to Lt. Gen. John E. Hull, DC/S WD, 3 Oct. 1945; ltr., Lt. Col. H. V. Maull, CO Columbia AAB, S.C., to CG 1st AF, 29 June 1945, all cited in AHS-64, pp. 67–74, 117–18.

72. Incls. to ltr., Hq. VIII Service Comd., Dallas, Texas, to Intel. Off., 301st AAFFTD, Corsicana, Texas, 10 Nov. 1943; ltr., CFTC to AFTRC, 31 Aug. 1944; Maj. Gen. R. L. Walsh, Spec. Asst. to CG AAF to Lt. Gen. I. C. Eaker, C/AS, 1 June 1945, all cited in AHS-64, pp. 74–77, 119.

73. Ltr., Air Cdre. G. C. Pirie, British air attaché to Brig. Gen. Davenport Johnson, 22 May 1941; ltr., Col. E S. Patterson, Actg. Air JA to Lt. Col. W. J. Wilkinds, Staff JA, Hq. 2d AF, Colorado Springs, Colo., 18 Sept. 1944, all cited in AHS-64, pp. 78–79, 119.

APPENDIX

APPENDIX

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*AAF STAFF AND COMMAND ASSIGNMENTS, JUNE 1941–AUGUST 1945**

CHIEF, ARMY AIR FORCES
Maj.–Lt. Gen. H. H. Arnold
20 June 41–9 Mar. 42

COMMANDING GENERAL, ARMY AIR FORCES
Lt. Gen.–General of the Army H. H. Arnold
9 Mar. 42–

CHIEF OF AIR CORPS
Maj. Gen. G. H. Brett
30 May 41–8 Dec. 41
Maj. Gen. W. R. Weaver (Actg.)
8 Dec. 41–9 Mar. 42

ASST. CHIEF OF AIR CORPS
Brig. Gen. D. Johnson
2 Oct. 40–8 Aug. 41
Brig. Gen. M. S. Fairchild
8 Aug. 41–9 Mar. 42

COMMANDING GENERAL, AIR FORCE COMBAT COMMAND
Lt. Gen. D. C. Emmons
1 Mar. 39–17 Dec. 41
Maj. Gen. M. F. Harmon (Actg.)
17 Dec. 41–26 Jan. 42
Maj. Gen. C. Spaatz
27 Jan. 42–8 Mar. 42

CHIEF OF AIR STAFF; DEPUTY COMMANDER AND CHIEF OF AIR STAFF
Brig. Gen. C. Spaatz
20 June 41–26 Jan. 42
Maj. Gen. M. F. Harmon
27 Jan. 42–6 July 42
Maj. Gen. G. E. Stratemeyer
6 July 42–26 July 43
Maj.–Lt. Gen. B. M. Giles
26 July 43–30 Apr. 45
Lt. Gen. I. C. Eaker
30 Apr. 45–2 June 45
Maj. Gen. C. C. Chauncey (Actg.)
2 June 45–

DEPUTY CHIEF OF STAFF†
Brig. Gen. L. S. Kuter
9 Mar. 42–17 Oct. 42
Brig. Gen. T. J. Hanley
17 Oct. 42–25 June 43
Brig. Gen. L. G. Saunders
29 Mar. 43–25 Aug. 43
Brig. Gen. W. E. Hall
29 Mar. 43–4 Sept. 44
Brig. Gen. E. S. Perrin
25 June 43–29 Apr. 44
Brig. Gen. H. S. Vandenberg
25 Aug. 43–16 Mar. 44
Brig. Gen. H. S. Hansell
23 Oct. 43–20 Aug. 44

* Prepared by Juliette A. Hennessy, USAF Historical Division. Except when otherwise given, the inclusive dates are 20 June 1941 and 14 August 1945.

† The Deputy Chiefs of Staff were "trouble shooters" for the Commanding General and Chief of Air Staff, AAF. They usually were given specific assignments in definite areas, such as operations or materiel, according to need. The number of them varied from time to time.

Brig. Gen. P. W. Timberlake
29 Apr. 44–3 July 45
Brig. Gen. D. Wilson
10 May 44–2 Sept. 44
Brig. Gen. R. O. Owens
3 July 44–15 May 45
Brig.–Maj. Gen. L. Norstad
20 Aug. 44–8 May 45
Brig. Gen. F. H. Smith
2 Sept. 44–15 Jan. 45
Brig. Gen. R. C. Hood
18 Jan. 45–

CHIEF OF STAFF, 20TH AF*
Brig. Gen. H. S. Hansell
6 Apr. 44–20 Aug. 44
Brig.–Maj. Gen. L. Norstad
20 Aug. 44–8 May 45

CHIEF, PLANS SECTION, OCAC; ASST. EXEC. FOR ADMINISTRATIVE PLANNING AND COORDINATION, OCAC; DIRECTOR, MANAGEMENT CONTROL; AC/AS, MANAGEMENT CONTROL
Col.–Brig. Gen. B. E. Gates
20 June 41–25 June 45
Col. R. E. S. Deichler (Actg.)
25 June 45–

DIRECTOR OF MILITARY REQUIREMENTS
Brig.–Maj. Gen. M. S. Fairchild
9 Mar. 42–25 Nov. 42
Maj. Gen. D. Johnson
26 Nov. 42–24 Feb. 43
Col. M. E. Gross (Actg.)
25 Feb. 43–14 Mar. 43
Maj. Gen. B. M. Giles
15 Mar. 43–29 Mar. 43

DIRECTOR OF TECHNICAL SERVICES
Col. R. G. Breene
9 Mar. 42–10 July 42
Col. A. W. Marriner (Actg.)
10 July 42–16 July 42
Brig. Gen. H. M. McClelland
16 July 42–29 Mar. 43

DIRECTOR OF PERSONNEL
Col.–Brig. Gen. J. M. Bevans
9 Mar. 42–29 Mar. 43

CHIEF, PLANS; AC/AS, PLANS
Lt. Col.–Col. H. L. George
20 June 41–9 Mar. 42
Col. H. A. Craig
9 Mar. 42–18 July 42
Col.–Brig. Gen. O. A. Anderson
18 July 42–8 July 43
Brig.–Maj. Gen. L. S. Kuter
8 July 43–8 May 45
Brig. Gen. J. L. Loutzenheiser (Actg.)
8 May 45–27 June 45
Maj. Gen. L. Norstad
27 June 45–

A-1; AC/AS, PERSONNEL
Brig. Gen. R. P. Cousins
7 July 41–12 Jan. 42
Col. F. T. Davison
12 Jan. 42–29 Mar. 43
Brig.–Maj. Gen. J. M. Bevans
29 Mar. 43–20 Feb. 45
Maj. Gen. H. R. Harmon
20 Feb. 45–7 June 45
Maj. Gen. F. L. Anderson
7 June 45–

A-2; AC/AS, INTELLIGENCE
Brig. Gen. M. F. Scanlon
20 June 41–21 Feb. 42
Col. R. L. Walsh
21 Feb. 42–30 May 42
Brig. Gen. H. Peabody
30 May 42–22 June 42
Col.–Brig. Gen. E. P. Sorensen
22 June 42–21 Oct. 43
Maj. Gen. C. L. Bissell
21 Oct. 43–5 Jan. 44
Brig. Gen. T. D. White
5 Jan. 44–2 Sept. 44
Maj. Gen. J. P. Hodges
2 Sept. 44–7 July 45
Maj. Gen. E. R. Quesada
7 July 45–

* The men serving in this post occupied dual positions as Deputy Chiefs of Staff, AAF and Chiefs of Staff, 20th AF.

AC/AS, OPERATIONS, COMMITMENTS, AND REQUIREMENTS
Maj. Gen. B. M. Giles
29 Mar. 43–26 July 43
Brig. Gen. H. M. McClelland (Actg.)
26 July 43–11 Aug. 43
Brig.–Maj. Gen. H. A. Craig
11 Aug. 43–25 Oct. 44
Brig.–Maj. Gen. D. Wilson
25 Oct. 44–25 June 45
Lt. Gen. H. S. Vandenberg
26 June 45–16 July 45

A-3; AC/AS, TRAINING
Col.–Brig. Gen. E. L. Naiden
20 June 41–27 Jan. 42
Col. H. S. Vandenberg
27 Jan. 42–12 Aug. 42
Col.–Maj. Gen. R. W. Harper
12 Aug. 42–20 Sept. 44
Brig. Gen. W. W. Welsh
20 Sept. 44–16 July 45
Lt. Gen. H. S. Vandenberg
16 July 45–

A-4; AC/AS, MATERIEL, MAINTENANCE, AND DISTRIBUTION; AC/AS, MATERIEL AND SERVICES
Col. E. P. Sorensen
20 June 41–4 Jan. 42
Col.–Brig. Gen. T. J. Hanley
4 Jan. 42–17 Oct. 42
Col. R. H. Ballard
17 Oct. 42–29 Mar. 43
Maj. Gen. O. P. Echols
29 Mar. 43–27 Apr. 45
Brig.–Maj. Gen. E. M. Powers (Actg.)
27 Apr. 45–

AC/AS, PROGRAM PLANNING
Col. A. L. Moore
9 Sept. 42–29 Mar. 43

AIR ADJUTANT GENERAL
Col. W. W. Dick
20 June 41–19 Sept. 42
Col. F. C. Milner
19 Sept. 42–28 Sept. 43
Col. J. B. Cooley*
28 Sept. 43–15 Dec. 43
Lt. Col. H. H. Hewitt (Actg.)
15 Dec. 43–27 Dec. 43
Col. T. A. FitzPatrick
27 Dec. 43–8 May 44
Col. H. G. Culton†
8 June 45–

AIR INSPECTOR
Brig. Gen. H. A. Dargue
20 June 41–24 July 41
Col. E. W. Hill
24 July 41–18 July 42
Col. J. W. Whiteley
18 July 42–28 Mar. 43
Maj. Gen. F. Bradley
28 Mar. 43–13 July 43
Brig.–Maj. Gen. J. W. Jones
13 July 43–

CHIEF, LEGAL DIV., OCAC; AIR JUDGE ADVOCATE
Col. E. H. Snodgrass
20 June 41–3 July 43
Brig. Gen. L. H. Hedrick
3 July 43–14 Aug. 45

AIR SURGEON
Col.–Maj. Gen. D. N. W. Grant
30 Oct. 41–

SPECIAL PROJECTS COMMANDING OFFICER
Col. F. T. Davison
29 Mar. 43–

DIRECTOR OF FLYING SAFETY
Lt. Col.–Col. S. R. Harris
10 Mar. 42–29 Mar. 43

OFFICE OF FLYING SAFETY COMMANDING OFFICER
Col. G. C. Price
1 Oct. 43–

* Colonel Cooley was Acting AAG from 28 Sept. 43 to 29 Oct. 43.

† No AAG from 8 May 44 to 8 June 45.

BUDGET AND FISCAL OFFICER
Brig. Gen. L. W. Miller
29 Mar. 43–10 July 45*

MILITARY DIRECTOR OF CIVIL AVIATION
Brig. Gen. D. H. Connolly
24 Apr. 42–15 Sept. 42

AIR COMMUNICATIONS OFFICER
Brig. Gen. H. M. McClelland
26 Sept. 43–

SPECIAL ASST. FOR GLIDER PROGRAM
Richard DuPont
19 Apr. 43–13 Sept. 43

SPECIAL ASST. FOR ANTIAIRCRAFT
Maj. Gen. H. R. Oldfield
26 Oct. 43–

OFFICE OF LEGISLATIVE SERVICES COMMANDING OFFICER
Col. W. S. Ege
11 Dec. 43–

PUBLIC RELATIONS OFFICER
Col. A. I. Ennis
9 Mar. 42–9 Sept. 42

OFFICE OF TECHNICAL INFORMATION; OFFICE OF INFORMATION SERVICES COMMANDING OFFICER
Lt. Col.–Col. R. W. D. Smith
1 Apr. 44–

FIRST AIR FORCE COMMANDING GENERAL
Maj. Gen. J. E. Chaney
16 Jan. 41–15 May 41
Brig. Gen. A. N. Krogstad
15 May 41–24 June 41
Maj. Gen. H. A. Dargue
24 June 41–2 Sept. 41
Brig. Gen. J. C. McDonnell
2 Sept. 41–16 Sept. 41
Col. E. A. Lohman
16 Sept. 41–21 Sept. 41
Brig. Gen. J. C. McDonnell
21 Sept. 41–1 Oct. 41
Maj. Gen. H. A. Dargue
1 Oct. 41–10 Dec. 41
Brig. Gen. A. N. Krogstad
10 Dec. 41–4 Mar. 42
Brig. Gen. J. K. Cannon
4 Mar. 42–5 Mar. 42
Maj. Gen. F. Bradley
5 Mar. 42–12 July 42
Brig. Gen. J. K. Cannon
12 July 42–23 July 42
Maj. Gen. J. E. Chaney
23 July 42–18 Apr. 43
Maj. Gen. R. Royce
18 Apr. 43–2 Sept. 43
Brig. Gen. W. T. Larson
2 Sept. 43–10 Sept. 43
Brig. Gen. G. O. Barcus
10 Sept. 43–17 Sept. 43
Brig.–Maj. Gen. F. O'D. Hunter
17 Sept. 43–

SECOND AIR FORCE COMMANDING GENERAL
Maj. Gen. J. F. Curry
16 Jan. 41–5 Aug. 41
Maj. Gen. M. F. Harmon
5 Aug. 41–19 Dec. 41
Brig. Gen. J. B. Brooks
19 Dec. 41–28 Jan. 42
Brig. Gen. C. H. Wash
28 Jan. 42–31 Jan. 42
Maj. Gen. F. L. Martin
1 Feb. 42–14 May 42
Maj. Gen. R. Olds
14 May 42–25 Feb. 43
Maj. Gen. D. Johnson
25 Feb. 43–25 July 43
Brig. Gen. E. L. Eubank
25 July 43–25 Aug. 43
Maj. Gen. D. Johnson
25 Aug. 43–9 Sept. 43
Maj. Gen. St. C. Streett
9 Sept. 43–15 Jan. 44
Brig.–Maj. Gen. U. G. Ent
15 Jan. 44–28 Oct. 44
Maj. Gen. R. B. Williams
28 Oct. 44–

* Miller had been Chief of Fiscal Div., OCAC from 20 Aug 41 to 9 Mar 42, and Budget Officer from 9 Mar 42 to 29 Mar 43. Between these last given dates Col. A. W. Martenstein served as Fiscal Officer.

THIRD AIR FORCE COMMANDING GENERAL

Maj. Gen. B. K. Yount
16 Jan. 41–18 July 41*
Maj. Gen. L. H. Brereton
29 July 41–14 Oct. 41
Maj. Gen. W. H. Frank
14 Oct. 41–24 June 42
Brig. Gen. C. H. Wash
25 June 42–26 Nov. 42*
Brig. Gen. A. H. Gilkeson
1 Dec. 42–12 Dec. 42
Maj. Gen. St. C. Streett
12 Dec. 42–8 Sept. 43
Brig. Gen. A. H. Gilkeson
8 Sept. 43–11 Sept. 43
Brig.–Maj. Gen. W. T. Larson
11 Sept. 43–14 May 45
Brig. Gen. E. C. Lynch
14 May 45–26 May 45
Brig. Gen. T. W. Blackburn
26 May 45–30 June 45
Lt. Gen. L. H. Brereton
1 July 45–

FOURTH AIR FORCE COMMANDING GENERAL

Maj. Gen. J. E. Fickel
16 Jan. 41–2 Apr. 42
Maj. Gen. G. C. Kenney
2 Apr. 42–22 July 42
Maj. Gen. B. M. Giles
22 July 42–18 Mar. 43
Brig.–Maj. Gen. W. E. Kepner
18 Mar. 43–8 July 43
Brig.–Maj. Gen. W. E. Lynd
8 July 43–14 July 44
Brig.–Maj. Gen. J. E. Parker
14 July 44–19 May 45
Brig. Gen. E. M. Morris
19 May 45–6 July 45
Maj. Gen. W. H. Hale
6 July 45–

CONTINENTAL AIR FORCES COMMANDING GENERAL

Brig. Gen. E. H. Beebe
15 Dec. 44–1 Mar. 45
Maj. Gen. St. C. Streett
1 Mar. 45–1 July 45
Gen. H. H. Arnold
1 July 45–

TECHNICAL TRAINING COMMAND COMMANDING GENERAL

Brig.–Maj. Gen. R. B. Lincoln
26 Mar. 41–12 Feb. 42
Maj. Gen. W. R. Weaver
18 Feb. 42–7 July 43

FLYING TRAINING COMMAND COMMANDING GENERAL

Maj. Gen. B. K. Yount
28 Jan. 42–7 July 43

AAF TRAINING COMMAND COMMANDING GENERAL

Maj.–Lt. Gen. B. K. Yount
7 July 43–

FERRYING COMMAND; AIR TRANSPORT COMMAND COMMANDING OFFICER

Col.–Brig. Gen. R. Olds
29 May 41–1 Apr. 42
Col.–Lt. Gen. H. L. George
1 Apr. 42–

PROVING GROUND COMMAND COMMANDING OFFICER

Col.–Brig. Gen. G. Gardner
25 Mar. 42–19 July 45

AIR CORPS MAINTENANCE COMMAND; AIR SERVICE COMMAND COMMANDING GENERAL

Brig.–Maj. Gen. H. J. F. Miller
15 Mar. 41–19 Nov. 42
Maj. Gen. W. H. Frank
19 Nov. 42–17 July 44
Maj. Gen. C. McMullen (Actg.)†
17 July 44–31 Aug. 44

*It was impossible to determine who was acting as commanding general of the Third Air Force from 18 July to 29 July 1941 and from 26 November to 1 December 1942.

† Maj. Gen. D. H. Dunton was appointed to this post but went to the hospital on the day he was to assume command.

MATERIEL COMMAND COMMANDING GENERAL

Brig.–Maj. Gen. O. P. Echols
9 Mar. 42–27 Mar. 43
Brig.–Maj. Gen. C. E. Branshaw
27 Mar. 43–17 July 44
Brig. Gen. K. B. Wolfe
17 July 44–31 Aug. 44

AAF MATERIEL AND SERVICES; AIR TECHNICAL SERVICE COMMAND COMMANDING GENERAL

Lt. Gen. W. S. Knudsen
26 July 44–30 Apr. 45
Maj. Gen. B. E. Meyers
30 Apr. 45–1 June 45
Maj. Gen. L. T. Miller (Actg.)
1 June 45–30 June 45
Maj. Gen. H. J. Knerr
1 July 45–

AIR TRANSPORT COMMAND; I TROOP CARRIER COMMAND COMMANDING OFFICER

Col.–Brig. Gen. F. S. Borum
30 Apr. 42–3 Aug. 43
Col. R. G. Landis
3 Aug. 43–4 Oct. 43
Brig. Gen. F. W. Evans
4 Oct. 43–26 Aug. 44
Brig. Gen. W. D. Old
26 Aug. 44–

AAF FOREIGN SERVICE CONCENTRATION COMMAND; I CONCENTRATION COMMAND COMMANDING GENERAL

Brig. Gen. W. O. Ryan
19 June 42–21 Nov. 42

ANTISUBMARINE COMMAND COMMANDING GENERAL

Brig. Gen. W. T. Larson
15 Oct. 42–24 Aug. 43

SCHOOL OF APPLIED TACTICS; AAF TACTICAL CENTER; AAF CENTER COMMANDING GENERAL

Brig. Gen. H. Peabody
15 Nov. 42–16 Mar. 44
Maj. Gen. E. J. House
16 Mar. 44–25 June 45*
Maj. Gen. G. Gardner (Actg.)
1 June 45–1 July 45
Maj. Gen. D. Wilson
1 July 45–

FLIGHT CONTROL COMMAND COMMANDING OFFICER

Col. S. R. Harris
29 Mar. 43–1 Oct. 43

AAF REDISTRIBUTION CENTER; AAF PERSONNEL DISTRIBUTION COMMAND COMMANDING OFFICER

Col. H. M. Bailey
16 Aug. 43–1 July 44
Maj. Gen. H. R. Harmon
1 July 44–15 Feb. 45
Maj. Gen. R. Royce
15 Feb. 45–

AAF WEATHER SERVICE COMMANDING OFFICER

Col. D. N. Yates
1 July 45–

* General House was on leave from 1 to 25 June 1945 pending retirement, and General Gardner, head of the Proving Ground Command (which had come under the AAF Center on 1 June 1945), became Acting Commanding General.

GLOSSARY

GLOSSARY

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AA	Antiaircraft (or Antiaircraft artillery)
AAFSAT	AAF School of Applied Tactics
AAFTAC	AAF Tactical Center
ABC	American-British Conversations (January–March 1941)
AC/AS	Assistant Chief of Air Staff
ACER	Air Corps Enlisted Reserve
AFCC	Air Force Combat Command
AGCT	Army General Classification Test
AGF	Army Ground Forces
AGP	Aircraft grounded for lack of parts
AM	Air Marshal
ANSCOL	Army-Navy Staff College
APB	Aircraft Production Board
ARCO	Aircraft Resources Control Office
ASC	Air Service Command
ASF	Army Service Forces
ASWAAF	Arms and Services with the AAF
ATC	Air Transport Command
ATSC	Air Technical Service Command
AVM	Air Vice-Marshal
AWPD	Air War Plans Division
AWS	Aircraft warning service
AWUTC	Aircraft Warning Unit Training Center
BTC	Basic training center
BTO	Bombing through overcast
CAA	Civil Aeronautics Administration (or Authority)
CAF	Continental Air Forces
CARW	Civilian air-raid warning system
CBI	China-Burma-India
CCS	Combined Chiefs of Staff
CCTS	Combat crew training school (or station)
CIO	Congress of Industrial Organizations

COA	Committee of Operations Analysts
CTD	Consolidated training directive
CWS	Chemical Warfare Service
DAO	Defense Aid Organization
D/F	Direction finding
EDC	Eastern Defense Command
ETO	European Theater of Operations
FSS	Field Service Section
GCI	Ground-controlled interception
GFE	Government-furnished equipment
GHQ	General Headquarters
HF	High frequency
IFF	Identification friend or foe
JAC	Joint Aircraft Committee
JCS	Joint Chiefs of Staff
JWPC	Joint War Plans Committee
MA	Mechanical aptitude test
MAC	Munitions Assignments Committee (Air)
M&S	Materiel and Services
MIT	Massachusetts Institute of Technology
MM&D	Materiel, Maintenance, and Distribution
MTO	Mediterranean Theater of Operations
MTU	Mobile training unit
NACA	National Advisory Committee for Aeronautics
NDAC	National Defense Advisory Commission
NDRC	National Defense Research Committee
NEI	Netherlands East Indies
OCAC	Office, Chief of Air Corps
OC&R	Operations, Commitments, and Requirements
OCS	Officer candidate school
OPD	Operations Division (War Department General Staff)
OPM	Office of Production Management
ORD	Overseas replacement depot
OSRD	Office of Scientific Research and Development
OTS	Officer training school
OTU	Operational training unit
PAA	Pan American Airways System
PDC	AAF Personnel Distribution Command
POE	Port of embarkation

POM	Preparation for overseas movement
RAF	Royal Air Force
RCAF	Royal Canadian Air Force
ROM	Radio operator-mechanic
RTU	Replacement training unit
SCR	Signal Corps Radio
SOS	Services of Supply
SPOG	Special Observer Group
SWPA	Southwest Pacific Area
TAG	The Adjutant General
T/O	Table of organization
TORCH	Allied landings in North and northwest Africa, November 1942
TTC	Technical Training Command
UR	Unsatisfactory Report
VHB	Very heavy bomber
VHF	Very high frequency
VLR	Very long range
WAAC	Women's Army Auxiliary Corps
WASP	Women Airforce Service Pilots
W/C	Wing Commander
WCTC	West Coast Training Center
WD	War Department
WDGS	War Department General Staff
WPA	Works Progress Administration
WPB	War Production Board
WPD	War Plans Division
ZEC-2	Airplane carrier (converted C-3 type cargo vessel)

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